

February 22, 1960

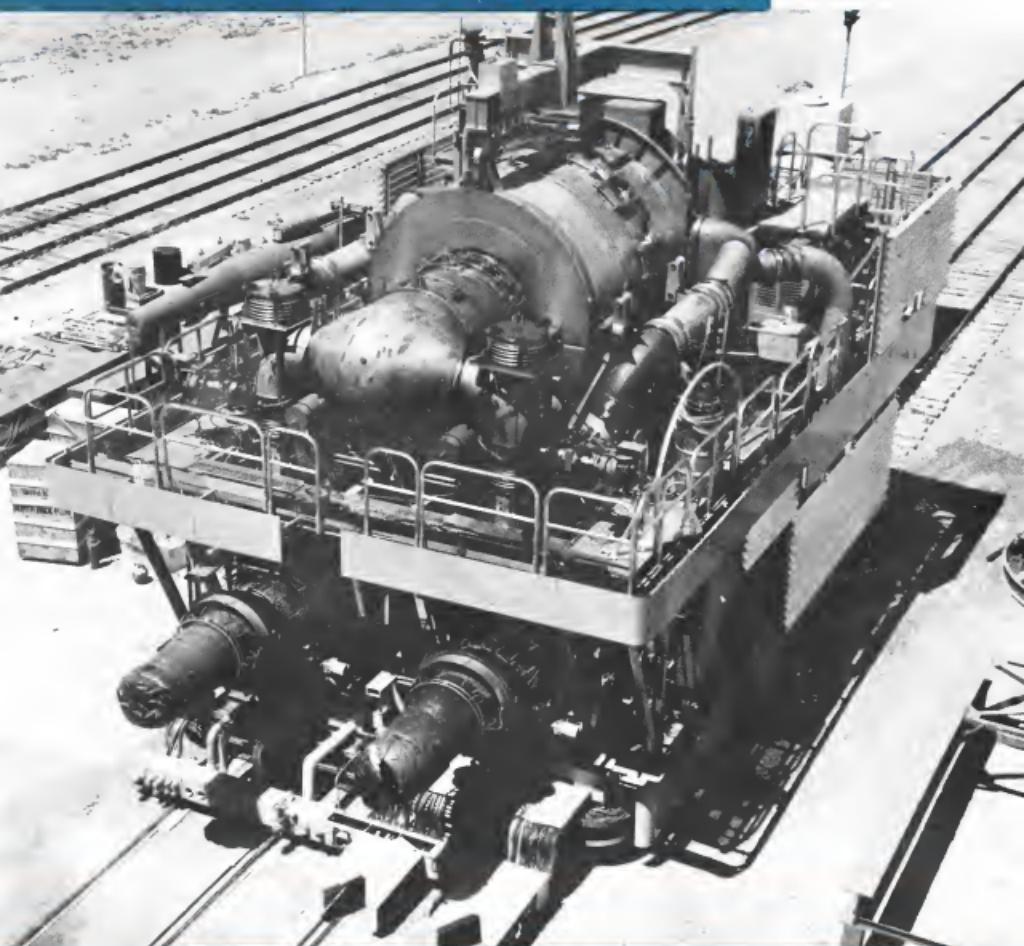
Aviation Week and Space Technology

75 Cents

A McGraw-Hill Publication

Beech Speeds
Plans For
Turbine Planes

GE Jet Engine
Nuclear Reactor



Industry Surveys Hydrofoil Field

CRYOGENIC TRANSFER PUMPS

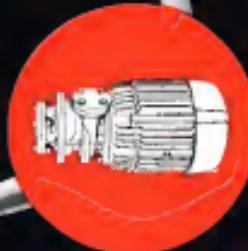
Centrifugal pumps, developed and produced by our Turbomachinery Division, handle hydrogen, oxygen, nitrogen, fluorine, and fluorides. Standard designs are immediately available, or can be adapted to meet special requirements for pumping any and all rocket propellants.

- Low Net Positive Suction Head offers advantage of armoring from unpressurized tanks, with significant large installation savings
- Capacity from 50 to 5000 gpm
- Pressure rises from 80 to 2000 psi
- Light weight and weight, resulting in low break-off during system cooldown
- Leak-proof sealing system for safely handling hazardous fluids
- Variable-speed electric motor pump drive for varying pump output requirements

Aerojet-General
CORPORATION
Santa Ana, California



Ergonomics, Health and Safety in the Construction Sector of Brazil



100% more Twitter users provide biographical information, are satisfied by service, and used it to

Still Another Hydro-Aire Product for
the *Aircraft* and *Missile* Industries

The Hydro-Aire fuel booster pump shown above is typical of a universally accepted family of pumps—known around the world—flows around the world. As used in jet fighters, bombers, and missiles, this pump is lighter—weighing only 6.8 pounds—is lower in cost, has proven much more reliable. It pumps 20,000 pounds of fuel per hour at 16 psig minimum. Ambient temperature range is -63°F to 250°F at sea level to 100,000 ft. altitude. These units consistently demonstrate excellent dry running, vapor and ice handling characteristics.

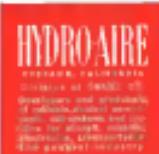
Afterburner Fuel System Diagrams

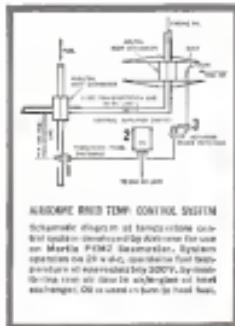
Hydro-Air is an air supply pump, subsystem or system to handle Argon, JP fuel, water, airless, liquid nitrogen, liquid oxygen, hydraulic oil and engine oil. They can be supplied electric motor driven, hydraulic motor driven, airless driven or turbine driven.

Serial port requirements are noted for information.

Engineers: Interesting opportunities are available. Write or call Mr. Douglas Nickerson, Chief Engineer, 1900 Winona, Ames, Barbara.

What happens if you win?





Airborne Bired Temp. Control System

Schematic diagram of birefringent temperature control system. The system uses an air pump, a PIREX pump, a valve, a sensor, and a control unit (BIRED) to regulate the temperature of an aircraft's fuel system. The system can operate at 20° F above the temperature of the aircraft's fuel system. The system can also be used for aircraft cooling systems.



Airborne electromechanical system regulates jet fuel temperature

An integral part of each aircraft engine installation on the Martin P6M2 Seastar is an Airborne R-5010 aircraft-regulated temperature control system. By adjusting air flow through a heat exchanger, this system maintains supply line fuel at 100-230°F.

As developed for the P6M2, the R-5010 consists of a fixed master valve, a control actuator and a rotary valve. The probe (insulated by an MS10073-12-Ring) is in direct contact with the temperature-regulated fuel and presents to the actuator a resistance which is proportional to fuel temperature. In response, the control box energizes the actuator to change the setting of a fixed or variable valve, thus regulating the fuel temperature at the heat exchanger. The sensing and response coordinates total guaranteed fuel temperature

it attained, at which point the system reaches a state of electrical balance.

A safety feature in this system is the event of power failure, a magnetic clutch in the actuator is released, permitting the air valve to be peaked open by the force of the main air.

This application is the P6M2 illustrates only one of many possible applications of the Airborne R-5010 system for aircraft control functions on aircraft, missiles and related equipments: cabin temperature control, engine temperature control, temperature regulation of fuel oil, aircraft cooling packages, etc. If you have requirements in these areas, we will be happy to make a proposal. Contact any of our offices.

Described in detail in our Bulletin P54-4, available on request.



Engineered Equipment for Aircraft and Industry

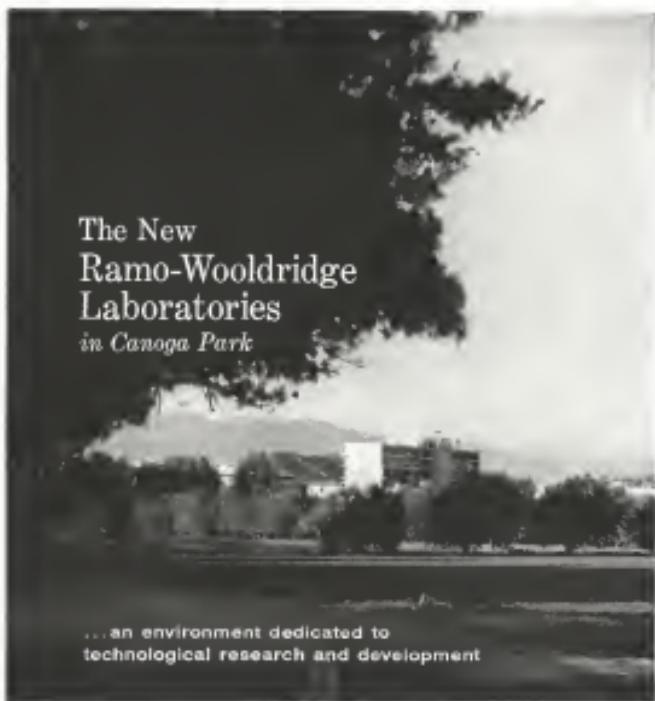
AIRBORNE ACCESSORIES CORPORATION
HILLSDALE 6, NEW JERSEY • OFFICES IN LOS ANGELES AND GENEVA

AVIATION CALENDAR

(Continued from page 5)

Jan. 20—Professional Group on Human Factors in Electronics
Apr. 5-10—National Aerospace Meeting and Meeting of the First International Display Society of Aerospace Engineers, Commodore Hotel, New York
Apr. 6-8—Standards Congress of Society of Vehicle Engineers, Baltimore Hotel, State Building, Calif. Sponsored American Society of Materials and Materials Committee
Apr. 6-8-1960 National Meeting, Hyper Environment-Space Factors, Institute of Environmental Sciences, Glendale Hotel, Los Angeles, Calif.
Apr. 11-13—Electrical Engineering in Space Technology, Hotel Baker, Delray, Fla. Sponsored American Institute of Electrical Engineers
Apr. 14-16—Annual Spring Technical Conference, Institute of Radio Engineers in cooperation with the American Rocket Society, Hotel Shaw, Cincinnati, Ohio
Apr. 19-21—National Meeting on Aircraft Structures and Strength, Stevens Institute of Technology, New York, N.Y. Sponsored Polytechnic Institute of Brooklyn Department of Defense Research Agency, Institute of Radio Engineers
Apr. 20-22—National Symposium on Vibration Problems in Design of Air-Automobile Structures, Aerospace Institute, Los Angeles, Calif. Sponsored NASA, the Rand Corp.
Apr. 21—Annual Eastern Regional Meeting, Institute of Navigation, Key Bridge, Washington, D.C. Sponsored American Institute of Radio Engineers
Apr. 21-23—Annual Metal & Materials Conference, Metals and Materials for the Space Age, American Institute of Mining Metallurgical and Petroleum Engineers, Ambassador Hotel, Los Angeles
Apr. 27-28—National Meeting on Space Applications, Department of Defense, Institute of the American Society of Metal, Stevens Institute, Glendale, Calif.
Apr. 28-29—Symposium on Clinical Control Applications, Systems, Design, and Development Division, Wright-Patterson AFB, Ohio
May 1-6—National Aerospace Electronics Conference, Engineers and Managers Prod. Inst., Dayton, Ohio. Sponsored Institute of Radio Engineers
May 2-6—Annual National Flight Test Symposium, Instrument Systems of America, Santa Clara, Calif.
May 9-13—5th Symposium of the Institute of Radio Engineers' Professional Group on Vibration, Theory and Test, Coronado Hotel, Coronado, San Diego
May 18-19-20—Electronics Components Conference, Willard Hotel, Washington, D.C. Sponsored Institute of Radio Engineers, Professional Group on Components and Parts, Institute of Electrical and Electronic Engineers, Electronic Industries Assn., Western Electronic Manufacturers Assn.
May 19-21—Annual National Forum, American Helicopter Society, Sheraton Park Hotel, Washington, D.C.
Aug. 15-19-21—Annual Congress, International Astronautical Federation, Royal Institute of Technology, Stockholm, Sweden

The New Ramo-Wooldridge Laboratories in Canoga Park



...an environment dedicated to
technological research and development

modern environment necessary for creative work. The new laboratories will be the West Coast headquarters of Thompson Ramo Wooldridge for as well as the Ramo-Wooldridge division of TRW.

The Ramo-Wooldridge Laboratories are engaged in the broad fields of electronic systems technology, computers, and data processing. Outstanding opportunities exist for scientists and engineers.

For specific information on current openings write to Mr. D. L. Fiske.



THE RAMO-WOOLDRIDGE LABORATORIES

500 ELMWOOD AVENUE, CULVER CITY, CALIFORNIA

Electronic test and maintenance costs REDUCED 90% with the Tape-Programmed SUPERTESTER®



Drastically reduced test costs, increased equipment reliability and quality, incipient failure located during routine maintenance, decreased down time for vital equipment, production bottlenecks eliminated, no time wasted evaluating good units and needlessly replacing good components, exceedingly vulnerable in ground support—these are a few of the many reasons that CTI SuperTesters are so widely used and for all types of electronic and electrical testing from production to field maintenance. In making complete static and dynamic measurements an constituent results or in analyzing performance of entire systems, SuperTesters have demonstrated time and again their advantages over other test methods.

Proven to over one year of use, the Model 180 Tape-Programmed SuperTester is bringing a new reliability into automatic testing. With the auxiliary Tape Punch and Tape Duplicate, identical or revised copies of tapes can be made in seconds, an important feature where customer design changes are of concern. Copies of tapes used by the original equipment manufacturer can be supplied for field use, always ensuring that equipment is meeting the latest design specification. In addition, lengthy test specifications are eliminated and the test instruments for a large variety of units are kept to a minimum—use CTI SuperTesters.

Write for complete specifications on the Model 180. A brief outline of your test requirements will enable us to advise you in more detail on the application of our tester to your needs. Related CTI products are the Model 165 Cable-Harness Analyzer, Model 176 cold-programmed Component Tester, and Model 180 Superstrip.

CALIFORNIA TECHNICAL INDUSTRIES
DIVISION OF TECNION, INC.
EL MONTE, CALIFORNIA
Processor of Automatic Testing

The new Model 180 Tape-Programmed SuperTester has the time controlling feature that has made CTI automatic test equipment the leader in the field—high accuracy, go/no-go bridge measurements, while-in-test of tests and variable operations, and complete customer confidence in test results through fail-safe memory and self testing ability.

Engines. Camer applications are currently available at CTI.

Temperatures Made To Order... By General Motors!



Three sizes of Harrison oil coolers, available in various sizes.

EXCESS HEAT'S A STRANGER ON NEW BELL RANGER WITH RELIABLE HARRISON OIL COOLERS ON THE JOB!

Whether it's a swift lift or a long haul... the new Bell Ranger comes through with dependable performance. And Harrison keeps engine oil temperatures steady for safe, sure flights. Wherever Bell helicopters go—over mountains, marsh, jungle or desert—you'll find Harrison oil coolers on the job, guarding vital temperatures. Harrison—with a half century of experience in the heat-transfer field—is your assurance of top-quality products that are researched, designed and tested for proven reliability. If you have a cooling problem, rely on Harrison for the answer.

GM
HARRISON
TEMPERATURE MADE TO ORDER
AIRCRAFT, AUTOMOTIVE, MARINE AND INDUSTRIAL HEAT EXCHANGERS

HARRISON RADIATOR DIVISION, GENERAL MOTORS CORPORATION, LOCKPORT, NEW YORK



LOCATED BETWEEN PILOTS, women for Safety would give who's best as well as maximum command of plane in all cases. First passengers, impressed with successive pilot, give pilot maximum visual data of his research in flight.

Douglas DC-8 Jetliner Wins Acclaim

UNITED first of 18 airlines to fly new jets . . . called "major advance in air travel"

THE STORY BEHIND THE STORY

The new Douglas DC-8 Jetliner—carrying 140 passengers in luxury and comfort, at speeds up to 600 miles per hour, and as far as 5800 miles non-stop—is news in itself, but behind that news is the story of another, much forward in air travel . . . another example of leaders in many phases of the aviation industry working together to make air travel more satisfying to the public, and more profitable to airline operators.

Sperry's contribution was development of the SP-10 Flight Control System—the first such system designed especially for multi-engine commercial aviation. Engineered to provide maximum guidance of the 150-ton DC-8 in the atmosphere, of transports up to 10 miles a minute, the SP-10 enables pilots to fly with unprecedented speed and accuracy.

In developing the SP-10, Sperry drew on nearly 30 years of experience in automotive flight and instrumentation. Since Sperry built the first electronic pilot in 1912, thousands of aircraft, both military

and commercial, have depended upon Sperry for safe, comfortable and dependable flight.

For information, write Aerometrical Equipment Division, Sperry Gyroscope Company, Division of Sperry Rand Corporation, Great Neck, New York.

SPERRY



Helping to guarantee a vital "something" for a rainy day



hallicrafters *
QRC

The effectiveness of America's defense "miracles"—today and tomorrow—depends on instant availability of superior electronic weapons.

For over seven years, the Hallicrafters company has been answering this urgent need with QRC—Quick Reaction Capability.

For your electronic requirements . . . from single circuit to complete system . . . for application on land, sea, air or space . . . Hallicrafters QRC can provide you with this unique design and production service in electronics.

ENGINEERS: Join our rapidly expanding QRC team now. For complete information, address your inquiry to William F. Frankfort, Director of Engineering.

hallicrafters  company

MILITARY ELECTRONICS DIVISION CHICAGO 24, ILLINOIS

URGENT PROBLEMS RELIABLY SOLVED

engine power

BY CATERPILLAR

Sawyer AFB, Truax AFB CAT DIESEL ELECTRIC POWER assures adequate lighting in case of emergency

At K. E. Sawyer Air Force Base, Marquette, Michigan, a Caterpillar Diesel Electric Set supplies standby power for runway lighting. The set is equipped with automatic starting controls which enable it to pick up a full load in 4 to 8 seconds average.

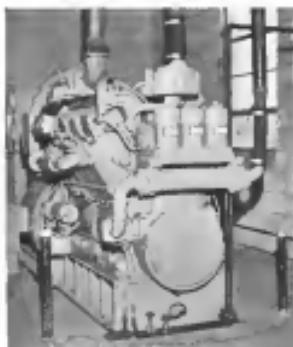
At Truax Air Force Base and Municipal Airport, Madison, Wisconsin, a Caterpillar B357 Series F Diesel Electric Set supplies emergency power for runway lighting and a CAA control tower. Landing beam lighting for controlled landings is also being installed at Truax.

Caterpillar Electric Sets supply any quantity of dependable power from 100 to 10,000 KVA. They are unusually efficient, 4 cycle engines which operate on sole diesel fuel, ranging from JP-1 to No. 2 furnace oil. They start easily, pick up load quickly and can be operated and maintained by unskilled personnel. Parts and service are available throughout the Free World.

Special high strength materials, strong reinforcing, unique part designs give Cat Electric Sets the ability to withstand extreme temperatures without losing their strength. At Air Force Bases or in the Atlantic, Cat Electric Sets have run over 20,000 hours without an overload, while supplying 60,000 kw per month.

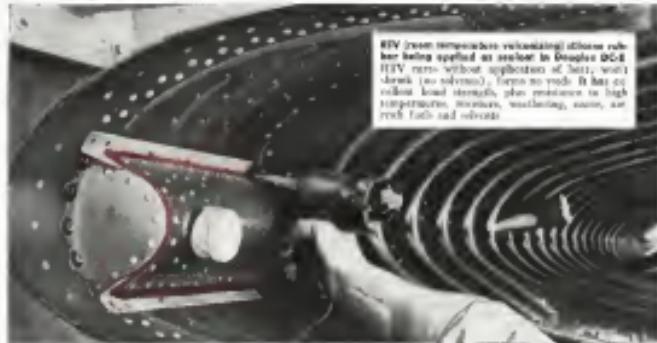
These are just a few reasons why Caterpillar Electric Sets are being used in many military and civilian airports. These include primary and standby power for lighting, starting engines, alert lights, radar systems, heating, heating, lighting and operating facilities.

Get the complete story on the advantages of Caterpillar Electric Sets. Write for our new booklet, "Guide Book on Emergency Power."



CATERPILLAR

Riley Division, Caterpillar Tractor Co., Peoria, Ill., U.S.A.
Write for booklet "Guide Book on Emergency Power."



G-E RTV silicone rubber—a superior material for tooling, encapsulating and sealing



Prototype (left) engine base cone (right) cast in RTV mold. Epoxy parts cast in flexible RTV mold have a bright, glossy surface and reproduce extremely fine detail. No parting line or registration marks are visible on the base cone, which can be quickly and conveniently replaced by using the broken part as a mold.



Cast-in-place, non-catalytic, flexible base cast complete in low cost, one piece RTV mold. Precautions such as placement of parts must be made to prevent damage to base cone, which can be quickly replaced by using the broken part as a mold.



Putting and base providing of electrical components, such as this aircraft transformer, are cast with RTV. It can be painted, primed, painted, plated or applied to de-icing. Excellent resistance to high altitude sun-oven and cosmic. Comes in wide viscosity ranges.

For applications data and samples of Standard Electric RTV
silicone rubber, write to Standard Electric Company, Silicones
Products Department, Butler 222, Waterford, N. Y.

GENERAL ELECTRIC

Silicone Products Dept., Waterford, N. Y.



DEPENDABLE SURVIVAL EQUIPMENT

The Air Cruisers escape slide shown here assists passengers and crew to evacuate the aircraft in an emergency in a matter of seconds without injury. Simple to operate, it is standard equipment on most turbine-powered passenger aircraft.

Thoroughly tested by the military and commercial airlines, the reliable escape slide is another major achievement in a field where Air Cruisers has been the leader for more than 30 years...dependable, lightweight survival equipment. The only manufacturer which can

conduct continuous research in survival equipment, Air Cruisers is America's most experienced fabricator of inflatables from rubbized nylon materials.

The Air Cruisers jet pump, which produces the rapid inflation vital to the fast, dependable operation of the escape slide, is another contribution toward better survival equipment. Today, more products, including life rafts, decompression bags, etc., are inflated by Air Cruisers jet pump than by any other kind.

Your inquiries are invited.



AIR CRUISERS DIVISION

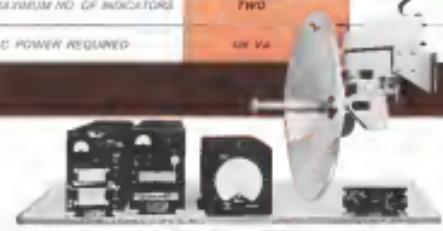
BELMONT, NEW JERSEY

LIFE JACKETS • LIFE RAFTS • HELICOPTER FLOATS • ESCAPE SLIDES • AIR CRUISERS BAGS • DECELERATION BELTS

BENDIX RDR-1D AIRBORNE WEATHER RADAR WINS IN SIDE-BY-SIDE COMPARISON!

Only Bendix has this proved performance superiority

BENDIX RDR-1D SYSTEM	OTHER X-BAND MAKE
STATION SPACE REQUIRED	2100 cu. in. (approx.)
RANGE	0.5° TO 150 MILES
STABILIZED ANTENNA	YES
SCAN ANGLE	180°
ANTENNA TILT	± 15°
WEIGHT	35 lbs.
MAXIMUM NO. OF INDICATORS	TWO
AC POWER REQUIRED	400 VA
	500 VA



New FAA regulations have put airborne weather radar in the spotlight... and emphasized once more the importance of using the most efficient system. Detailed comparison reveals that the Bendix RDR-1D System offers superior performance which means maximum flying safety for all types of aircraft.

The RDR-1D "sees" farther... up to 150 nautical miles. Its stabilized antenna prevents loss of picture

while maneuvering... and the wider main angle allows the pilot to see 50 per cent more target area.

Today over 1,200 Bendix Airborne Weather Radar Systems are now in daily service with airlines and business aircraft operators throughout the world.

For more details on the Bendix RDR-1D, the weather radar system with experience, write:

Bendix Radio Division

ATTENTION: GROUP 1, BALTIMORE 4, MARYLAND



VICKERS ECM COOLING SYSTEM plus 3M's FC-75 dissipates 47 kw input in 74 lb package

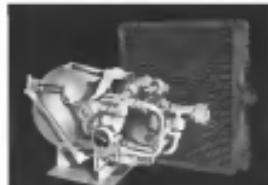
Vickers' 35 years of specializing in handling of fluids has been directed to "application-oriented" aircraft cooling systems—reliable systems that are light weight and feature a broad range of flow and pressure characteristics.

This typical Vickers system circulates Minnesota Mining and Manufacturing Co.'s heat dissipating dielectric coolant, FC-75, through Sperry's advanced design electronic countermeasures system.

Heart of the Vickers cooling system is a single-stage, centrifugal pump that generates relatively low pressure and moves fluids at high flow rates. Because it is inherently simple in design, the Vickers pump offers high reliability and simplified maintenance. Bearing design permits operation with fluids having low viscosities, in this instance FC-75, a fluorinated hydrocarbon.

Included in this package are safety interlocking drivers for the protection of the pumping unit and ECM system. Maximum operating efficiency is attained even under unusually severe operating requirements. Such assurance comes from Vickers' proven skills developed by long experience in designing and building components and systems for handling all types of fluid.

Write for Bulletin A-8244 for more details.



POWER UNIT AND COOLER. Liquid-cooled cooling system selected by Vickers Aero Hydraulics Division utilizes dielectric coolant (one of 3M's FC-75) dissipating dielectric coolant has been developed for aircraft applications. Other materials may be selected to be maintained at 100° F. with fluid flow rates as high as 30 gpm. Design is rugged, with a 100% safety factor. All parts are machined from solid aluminum and are fully anodized. 3000 hours below a part of the continuous testing program is required. The Vickers pump is used as a circulator which circulates and filters fluid.



AERO HYDRAULICS DIVISION
VICKERS INCORPORATED
DETROIT 32, MICHIGAN

division of
SPERRY RAND CORPORATION



THE RAW MATERIALS OF PROGRESS



HOW TO HOLD A JAM SESSION 8 MILES UP

Vickers active cooling system (inset) uses FC-75 as countermeasures system

Thermoelectric sophistication of electronic countermeasures systems poses many problems. Among these is the need to dissipate heat generated at the receiver/transistor and open-faced diodes associated in space and supersonic aircraft.

For the Sperry countermeasures system, a dissipating 51R/W is a 15-lb. package—was developed by Vickers using 3M Dielectric Coolant, FC-75.

This high stable of all fluids offered to electronics has high electric strength of 31KV. It is inherently non-conductive and possesses electro strength after repeated high voltage testing. It pour at -141°F

and boils at 311°F at one atmosphere... ideally suited for evaporation cooling.

Comparable with most materials, FC-75 is non-combustible, non-flammable, non-toxic, non-explosive and odorless. It is thermally stable in excess of 400° F., and will not decompose or burn under extreme temperature conditions. These properties make it ideal as a coolant.

Investigate the remarkable properties of 3M cast fluidic thermosets... point out product design, performance and performance predictions. For free literature, write to 3M Chemical Division, Dept. KAW-29 R. R. 1, Paul 6, Minn.

CHEMICAL DIVISION
MINNESOTA MINING AND MANUFACTURING COMPANY
... WHERE RESEARCH IS THE KEY TO TOMORROW





Johns Manville Announces... MIN-KLAD INTERLOK

...a new structural system interlocking Min-K insulation and high-temperature reinforced plastic

Min-K experience shows that in certain heat control situations no one material will perform as well as two for insulation and insulation with protective high-temperature facing.

Problem is how to effectively combine these materials into a structurally strong way? The answer is Min-Klad Interlok.

— a new structural system that interlocks Min-K insulation and reinforced plastic, metal or other high-temperature facing.

The result: one product that gives double strength, energy absorption of high-temperature plastic, or metal. Full-strength, insulation, rigidity? Insulation or insulation? High heat capacity?

gives the outstanding advantages of Min-Klad Interlok — an insulating core that has the lowest thermal conductivity available for service temperatures up to 300°F, steady state, and higher for transients. Min-K's thermal conductivity is actually lower than the molecular conductivity of still air.

Like all Min-K insulation, Min-Klad Interlok is factory-tensioned to your specifications and external skin panels, heat shields, cylindrical liners or component housings of any shape or size. Write today for technical specifications. Address: Johns-Manville, Box 14, New York 16, New York. In Canada, Port Credit, Ontario.

Wide range of features

For the hot fact, the minute designer can

specify Min-Klad Interlok in a wide variety of heat resistant and/or insulating materials—aluminum-phenolic (A/P), and similar surfacelaid plastics, as well as stainless steel and other heat-resistant metal foils and panels. For some requirements, the core fiber can be made of a different material—for example, one that offers characteristics acquired for bonding or fastening to other surfaces and parts.

Like all Min-K insulation, Min-Klad Interlok is factory-tensioned to your specifications and external skin panels, heat shields, cylindrical liners or component housings of any shape or size. Write today for technical specifications. Address: Johns-Manville, Box 14, New York 16, New York. In Canada, Port Credit, Ontario.

All the above components combine to provide a custom-made structural system for your



1) Core Insulation, 2) Interlocking with 3) Core, and 4) External Metal, Reinforced Plastic, and 5) Heat Shielding.



All the above components combine to provide a custom-made structural system for your

JOHNS-MANVILLE

EDITORIAL

Military Space Bid

(Maj Gen C J Ryland, commander of the Air Force Strategic Missile Division, recently defined what he termed the "strategic importance of space" and that "in the interests of national security and military space programs, the Air Force has the development order on a top priority basis. Because of the current debate over whether the military actually has a role in space and—if so—to what extent, ANALYSTS, WHILE INQUIRING before an interview of Gen. Ryland's speech before a Los Angeles meeting of the Institute of Space Engineers.)

We are no more up-to-date from the security point of view than we can ignore the son around us or the stratosphere just above us.

We are not venturing into space simply because it is there, but because space is the new medium where strategic operations can well be conducted with great effect. It does not take a student of military history to recognize that the nation which has the courage and the foresight to tap the advantages of new theories of operation, and to forge ahead into these new frontiers, will inevitably become the leader. Until the Soviet nuclear breakthrough of 1949, the United States possessed a monopoly both in the nuclear weapons and in the power to deliver it. That, in effect, was absolute dominance. From 1949 through the early 1950s we no longer held a monopoly in the nuclear field, but we still retained the edge in aerospace. Now, however, we hold no monopoly either in nuclear knowledge or in the means to deliver nuclear weapons.

Technology has progressed, time and distance have been minimized. The world, however, is not growing smaller. Rather, man's growing larger is his ability to command the forces of nature.

We are involved today in a conflict of ideologies with the Soviet Union. The so-called cold war is being waged along many fronts—political, social, economic, political, educational, and technological. If the Soviets achieve a substantial edge in missile and space weapon systems, the blackmail capability associated with such a margin of power could be used against the free world, perhaps as frequently as the weapons themselves. Conversely, the better equipped we are in nuclear hardware capabilities, the stronger will be our position of the strategic peace table.

Since it is imperative that we offset (Soviet) satellite by early warning and intelligence advantages by surveillance, we in the Air Force have taken concrete measures to develop space systems which will contribute substantially to our defense capabilities. Two specific programs are the satellite projects we call Midas and Sinos.

Midas (Missile Defense Alert System) is the Air Force answer to the requirement for early warning. It is the defender which will set sharply into the Soviet advantage of mobility. An ICBM travels a quarter of the distance around the world in about 10 minutes. Because of its incendiary speed it outruns even the transmission of information given us by our present warning systems. At this time we have no active defense against it.

Simultaneously with our development of Midas, we are proceeding with the Sinos program. Sinos is the

Air Force instrument for the global surveillance satellite system which will constitute the Soviet advantage of intelligence information. It is the three-prong military advantage of "high ground" suited to the near stratosphere.

When a nation is confronted with the risk of war, it is important that those who must make decisions have the benefit of current and valid information about the other nations involved. If that information is not available, the possibility of mistakes and miscalculations is increased.

By proceeding concurrently with all aspects of the development of ballistic missiles, i.e., the construction of bases and the training of personnel while the weapon is still undergoing research and test, we have demonstrated that calculation risk can pay off dividends in the forging of a major weapon system within a tightly-compressed time schedule. The same concept of concert, and the priorities and funds that go with it, should now be applied to the expedition development of our military space system.

We must meet the broad challenge of space. Through the intelligent exploitation and exploitation of space, man can extend his horizons, contribute to his comfort and welfare, and augment his knowledge. He can do none of these things, however, and I emphasize the fact, unless he commands the freedom and the means to exercise his full talents. In this critical age we must exploit all growing ventures into space. It is vital that we equip ourselves with the knowledge that must be evoked from the unknowns of space. Our two great objectives—to increase human knowledge and to defend human freedom—are inseparable to each other in fact, the civilian and military space programs are not contrary, but mutually productive.

In the very first flight, with warning and testbeds timely measured in minutes, effective communication will be a decisive element in future military operations.

While dependable, the delayed repeater communications system between a satellite and ground stations incurs some degree of delay in transmission. To overcome this the Advanced Research Projects Agency of the DOD is investigating the unique characteristics of 24-hour equatorial satellite systems. Three such satellites, each put into orbit 40,000 miles above the earth, would provide full night visibility in all points except those in the polar regions. Calculations show that a relatively low power radiated from the satellite to the ground station is sufficient for many necessities of broad bandwidth. Consequently, high capacity intercontinental communications will be possible.

We are well beyond the Black Rogers era of science fiction. Space is with us—and we must get with it if we are to reap the advantages there. For those who dominate the frontiers and have the daring to seek them. The stakes in this space race are astronomical; the rewards can be nothing beyond magnificence. The penalty for hardness, inflexibility, or complacency can be equally vast.



TRUE NORTH...anywhere-any time-any weather

A portable field instrument that finds true north anywhere is now available to America's new mobile Army. It is called ABLE and has been **TOTALY CLASSIFIED** by the U. S. Army. To D. E. S. AUTONETICS ABLE swiftly determines true north... day or night, in all weather, and anywhere in the world up to latitudes of 50 degrees.

The simplicity, speed, and precision of ABLE compared with surveying methods means a saving in time, men

power, and equipment... and is in keeping with the modus vivendi's concept of battlefield mobility.

Heart of the 100-pound, all-instrumented system is a high precision gyro which senses true north. Its accuracy is equal to most celestial methods under typical conditions. ABLE components have a mean time to failure in excess of 3000 hours. ABLE can also provide directional orientation for field operated mobile radar and missile launching.

Inertial instruments by Autonetics



A DIVISION OF NORTH AMERICAN AVIATION, INC. • 8000 GAITHER, WASHINGTON, D. C. 20545
INERTIAL NAVIGATION / ALIGNMENT AND FLIGHT CONTROL / COMPUTER AND DATA SYSTEMS

Washington Roundup

Apparently unassisted, Senator George F. Smathers over the defense issue won increased President Eisenhower's support. He should take more productive action to recruit Democratic support. First he went to Cape Canaveral, then he decided to discuss the issue on a national broadcast. And he decided to square the bickering in before leaving for Smith Station, indicating a concern over the recently increased potency of the issue.

Eisenhower apparently intends to let his military reputation against all enemies and depend on his prestige to carry him through the fight. He continues to argue his critics of known partnership and political associations. And he continues to stress his new military budget and the objectives of his top military officers.

A strong fight from Eisenhower can only support the administration position but probably not enough to offset Democratic control of the参议院. If the Democrats cling to their determination to make defense an election issue they have more than enough power to vote extra money for controversial projects like the North American T-38 Mach 3 fighter.

Mutual Security

Mutual security progress sputters headed for the usual deep congressional cuts this year. Estimates of cuts are as high as \$15 billion from the \$14.875 billion budget the President urged on Congress last week. Programs include about \$2 billion for military aid and this is unlikely to be the U. S. defense budget for the first year. Eisenhower's new \$2 billion is expected this year to still be the defense budget and popular.

Military assistance elements of the defense budget are ripe for cuts to make way for increased U. S. defense spending. Democrats are pressuring pressure for a bigger military effort and military aid is an easy place to cut to compensate for larger defense spending. This will keep the vital budget from going to zero and help the Democratic Congress see final responsibility.

Presidential advisers seem to be urging every loan to stand that the U. S. is not in a war with Russia. Senate admiral Dr. George B. Keaylocke has spoken of the scientific and technological project with the Soviet Union which could involve our national prestige and insurance, perhaps, our very survival. Earlier this month Secretary of State Christian A. Herter enjoyed some additional prestige in Soviet space satellites. He admitted Soviet achievements have won more glow than U. S. efforts.

Herter would last week against allowing weapons observers to do the world to ground war through assassination. He said a more stable military environment to control the design of a continuing arm race and stopping competition as strategic defense systems.

Electronics Boomerang?

Some electronic firms are urging the Electronic Industries Assn. fight against Japanese imports for p. 181 are increasing. Setting to not set imports of Japanese manufactured EIS has special interest government supported research and sale profits from electronic industry sales of electronic war or military products. Since EIS members are afraid the Defense Department might ask industry to apply this philosophy to development of defense electronic equipment.

There is little prospect for action this year on proposals for a single power agency. Sen. Robert Byrd (D. W. Va.) joined the cause of single agency sponsors last week, asking for an integrated civilian nuclear effort under one top-level official. President Eisenhower is strongly opposed to such a move and an old congressional support for it has developed.

State Department is expected to hold firm against heavy Dutch pressure for an air route to Los Angeles. Netherlands has told Secretary of State Herter of its disappointment and the Dutch government has passed a resolution asking the U. S. to assume an air route and permit XLVII Naval Dutch Airships to fly to Los Angeles. State is expected to stand by its refusal.

House Judiciary Subcommittee Chairman George H. Mahon has proposed bills to prohibit the federal control of railroad lines. Commerce Department has completed its study of national transportation policy and is in study to go to the White House for approval. Commerce, who is taking a permanent staff to conduct a continuing review of transport policy, is seeking Congress' support. Commerce will hold hearings that will be the continuation of AIA Board to the Civil Aeronautics Board.

—Washington Staff

Wrapup

U.S., Soviets Race to Develop Air-Launched Ballistic Missiles

Boeing B-52H will carry GAM-87A Sky Bolt; Soviet plans to use Bear turboprop, Bounder platforms.

Washington—United States and the Soviet Union are in a race to develop an operational air-launched ballistic missile. The U.S. program is based on the GAM-87A Sky Bolt ALBM which is projected to boost the strategic strength of nuclear bombers by adding a new generation of ground offensive punch.

The U.S. has decided to procure the Skys Bolt for use on the Boeing B-52G and B-52H jet bombers which are now carrying Honest Dog missiles (AW Feb 8, p 35).

The Soviet development program is already under way. Plans probably call to use the ALBM on the Bear turboprop strategic bombers now in service, or the Bounder supersonic delta now in flight test stages and, in particular, on its nuclear-powered reactors.

Decisions to put the WS-138A program (parent program for the Skys Bolt) into its development phase is based on design-objection, computation of an airframe margin, analysis, and favorable Department of Defense decisions would be Defense Department, Research and Development, Defense Research and Engineering, Defense Corp., Long Beach, Calif., and the Air Force Materiel Command, Wright-Patterson Air Force Base, Ohio.

• **Could the GAM-87A be developed to operational status within a reasonable period before the time when existing nuclear bombers may be considered to become obsolete?** This broad question may have been tied into a test-tube projection for initiating phases out of the North American GAM-77 Honest Dog air-launched air-to-surface missile in 1963 and phasing in the GAM-87A, at that time, with complete transition to the latter by 1965. The possible timetable structure for GAM-87A was based around *from* the possibility of some day having an improved performance version of Honest Dog, which is being planned by North American.

• **Could accuracy and reliability be developed, within the timetable limit, to give an "almost on target" hit capability required for a strategic weapon of this type?** By the time GAM-87A would become operational, weapon analysts find that its circular error probability (CEP) may be decreased in hundreds of feet.

Nuclear Warhead

The two stage solid-propellant GAM-87A missile to be developed by Douglas-Aircraft is the largest jet plane planned for air launch with a nuclear warhead. It is seen as industry weapon analysts as following the general pattern:

- Launch into a 200- to 300-mile-high out-of-atmosphere ballistic trajectory before the missile's speed drops from the initial altitude between 35,000 and 45,000 ft.
- Attain a speed of about 3,000 mph after launch, probably increasing at a substantially higher speed, for relative immunity to non-nuclear interceptors as it follows its trajectory for target impact.
- Spend a time of 1,000 to 3,000 seconds in flight on a direct course toward the bombing target by allowing it to release its weapon far from the target.

• **Could accuracy and reliability be developed, within the timetable limit, to give an "almost on target" hit capability required for a strategic weapon of this type?** By the time GAM-87A would become operational, weapon analysts find that its circular error probability (CEP) may be decreased in hundreds of feet.

Utilization of the GAM-87A is seen by industry analysts as involving cut the two:

- Boeing B-52 Model G (the development and operational model) and B-52H (the operational model) will be the only USAF bombers targeted to mount the GAM-87A, according to present projections based on the anticipated status of Strategic Air Command bomber inventory. The B-52 would carry one missile under each wing. Launch of a single missile can introduce a severe problem of atmospheric loading, since the missile can weigh in much as 10,000 lb. This may require enough of a weight reduction to seriously

• **British V Bomber**—Bristol-PAGE-Victor and Avro-Vulcan ML-2 aircraft will be modified to carry the GAM-87A—perhaps in a left position because of weight considerations. This application would be a scaled-down version of the massive British Avro Minerva and Royal Aircraft Establishment representatives were in the country last summer discussing details of possible deployment of GAM-87A on the Vulcan.

- **If a medium-range bomber is developed to operational status, it also would be armed with the GAM-87A.** Availability of the missile, at very least three to five years before a U.S. nuclear-powered plane might become operational, brings into sharp focus the critical importance of this type of missile for planned deployment in 1965.

• **GAM-87A** is required for use on USAF's Convair B-58. Failure to do so would result in force employment difficulties, particularly involving utilization of dual space between forward fuselage and wing root.

- **North American B-70 Mach 3 strategic bomber** also will not be programmed for armament with the missile. Under the original timetable for the B-70, first production delivery of an operational plane would not be before late in 1964, with first wing delivery not before late 1965. Strategic Air Command has been anxious to convert the GAM-87A to the B-70, probably attempting at least a five year extension on this plane, followed, perhaps, by transition to nuclear-powered bombers.

Initial Study

While waiting for the Defense Department signal to begin the development phase of WS-138A, which can involve the funding of approximately \$125 million, weapon analysts point out that Douglas Aircraft Co. had completed its initial staff effort. This basic staff had been funded with an additional \$3 million to carry it to the middle of February. Early in the year, Aerospace General

Ballistic Missile

had awarded the subcontract for the solid-propellant rocket motor. General Electric was given the job to develop the air-to-surface vehicle.

Let fall, Northrop Corp's Networks Division was awarded the missile guidance subsystem. Competition for a universal test set-ground checkout equipment for the missile was also scheduled. This was narrowed in three finalists, three contracts held in advance, with understand that Air Force itself would present this equipment instead of delegating development and procurement to a contractor.

Transition Period

During the transition period which usually follows the end of a feasibility study and leads into the research and development phase, Douglas gives a detailed prioritization of states and prioritization to a full government and industry complement consistent with the weapon system—including Department of Defense, Air Research and Development Command, USAF Headquarters, Strategic Air Command, Wright Air Development Division, project personnel, and industry members including Northrop Division, Aerospace General, and Boeing Airplane Co., and others. Apparently, this was Douglas' final input before the Department of Defense decision to support the following development plan:

A broad-based weapon system analysis investigation by industry companies was made to study the general parameters of an air-launched ballistic missile. These studies grew out of the subcontractor competition before Douglas was awarded the WS-138A contract.

Indications are that general characteristics and mission requirements for the weapon system would have to fall into these broad lines:

- **Solid propellant rocket motor** to give adequate performance for a weapon of this type would be about 25% longer overall and about 1 ft. in diameter. Allowing this to two stages probably would give a booster stage of about 18 ft. long, plus a second stage about 7 ft. long before the nose section. A single stage would also be applicable, but would introduce considerable uncertainty in range.

- **Booster stage** would have long and low fuel load to coincide with long booster combustion. Second stage probably would carry most warhead. One scheme might have carried warhead attached to a transverse rocket with jets in the nose but, in a solid-propellant gas generator for out-of-atmosphere control. Reverse thrust on fins in the leading edges of the causal



ARTIST'S conception of an air-launched ballistic missile shows flight pattern of the weapon is fired from a B-52 at low altitude. This starts re-entering atmosphere after missile impacts. After booster stage burns out, reentry the second stage would peak the workload to peak 40-mile before the weapon begins reentry for first impact on target.



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MISSILE would have high thrust and probably would never deviate from its borehole, stability fins on second stage.

velocity could operate to assist separation of second stage from payload. • As alternate plan, instead of using pitch for out-of-atmospheric control, modify exhaust thrust vectoring through use of pivots in the exhaust stream, or through use of swiveling nozzles, since each stage likely will use smaller multi-stage nozzle instead of a single large nozzle. Thrust chamber guidance is unlikely due to incompatibility involved.

• **Guidance technique** Likely will be for the missile to be cut loose from the launching aircraft at 20,000 ft. altitude, a minimum likely high altitude, with a safe margin of flight, but only a short fall would be programmed before the first stage would begin at a safe distance below the aircraft. A safety signal from the launching aircraft would start the missile from its pre- and flight-hazardous altitude into an ballistic trajectory. Burning time would be relatively short—probably less than a minute—but acceleration to peak altitude, perhaps 200 to 300 m higher than the boost point.

• **Flight performance** Computer inputs probably would "instruct" trajectory and target achievement. If target was not in the field of view, it will be fitted with a homing explosive of selecting a substantial number of alternate targets, according to a complex system of programming. Missile analysts find that as many as 20 alternate choices would not be unreasonable for a missile of this type if top effective strategic capability is to be achieved.

• **Targeting capability** will rely on prime emphasis, might be aimed at selecting an accuracy as the axis of hundreds of feet, anticipating entry capabilities at the time the GAM-87A would become operational. Clearly, but with this capability will be the ability to predict rocket motor thrust levels within a relatively low percentage of tolerance, both in the boomer and in the second stage.

• **Future improvements**, not likely to be required for first generation

operational missiles, might be the inclusion of a television capability in the nose, which could monitor a return back to the launching aircraft for its next, to identify the target on which the warhead would impact.

• **Warhead components** Undoubtedly will be involved. One of these areas would be consideration of whether single versus choice of一枚枚 warheads are, for a variety of this type, taking into consideration projected single warheads likely to be available when the missile is being developed and tested, that each extra payload of weight weight will likely nearly wipe out range capability.

• **Altitude-weight** lightweight nose cone probably will be favored—another detail in overall range. High temperature plastic nozzles for the type of service have been evaluated carefully by re-entry specialists.

• **Relatively shallow re-entry angle**—perhaps not exceeding 45 deg—likely would result from a trajectory pattern which would be calculated to combine a minimum out-of-atmosphere altitude with adequate horizontal "push." This shallow trajectory would cut down the heat transfer effects if a plastic nose cone material were used.

Initial study effort at Douglas has not been limited to theoretical analysis. Usual procedure is to investigate some of the more difficult design features in a few versions of the missile in model form with speeds ranging exceeding the speed projected for the operational missile. Jet for out-of-atmosphere control is one item which might be evaluated on feasibility studies.

Time of development will have to be considered, but if all the potential of the warhead is to be made available and single components, checklist approach is used to bring brought along concurrently to assist initial operational capability, which may take three years.

Considering the number of operational aircraft on which the weapon would be deployed, along with space requirements for storage in dispersed global locations, quantities for testing during the development phase and maintenance and training exercises to maintain operational efficiency, a total somewhere between 1,000 and 2,000 of the missiles probably would be required. This would require a gradual transition to a fairly high production rate—unfortunately, to even out of that attained with any surface-to-surface ballistic missile systems.

• **Armament test equipment** to service the missile's complex circuitry and sponsoring may be one of the factors contributing to the original development timetable delay before decision has not yet been reached for test act procurement. Estimates are that at least 35 of the test sets would be required to meet the demands of the development, production, and operational plans for the missile. Programming equipment probably would have to be transportable by air for availability of aircraft base.

Test set would track heavily the reliability of components and, in a study that remains to be done, would be held to a minimum. Capability to keep abreast of missile improvements also would have to be built into the test.

Soviet Pacific Tests for ICBMs?

Washington—Soviet Press News Bulletin released at the vehicles in missile tested by Russia as the Pacific Ocean is "powerful antiaircraft missile system," in a speech before the Indian Parliament. But the test aircraft after Moscow announced that the test flights would be made, all Soviet defense spoke of "reliability" as "essential," and the words "reliability" and "useful" were not used. Recently, however, both words have been used by Communist commentators [AVW Feb. 15, p. 31].

Contractors to Share Development Costs

By Philip J. Klass

Washington—Defense contractors beginning late 1 will have to dig into profits to underwrite part of the cost of company-initiated development programs which formerly were treated as fully allowable items of expense for cost and incentive-type contracts, according to new principles enunciated in a memo recently issued by Armed Services Procurement Regulation.

Air Force already has called in more than a dozen major contractors to tell them that they must not share the cost of company-initiated development. Air Force reportedly is asking companies to share about 30% of the cost of development programs, including those not involving any physical hardware.

USAF has enumerated considerable objection from industry to the new policy because contractors see it as an effort to blow up profit margins which many believe already are too low [AVW Jan. 15, p. 14].

The new Air Force policy, and the joint services policy which goes into effect July 1, do not apply to development programs specifically authorized by the services. However, this might be the next step.

Contractors initiated research—which the revised ASPR defines as the search for more knowledge or better understanding of differentiated from existing market which normally produces hardware—will receive more liberal treatment than in the past, however.

Industry, company-initiated research was not an allowable item of indirect cost under previous rules if it had been made to the company's defense cost trade. After July 1, such items still will be allowable, provided the company programs its research costs to all company products, including consumer and industrial as well as defense.

'Reasonable' Research

Company-initiated research and development cost bids must pass the test of "reasonableness" before they can be included in the contract cost under the new ASPR revision. In calculating whether a given program meets this criteria, procurement authorities will consider cost, cost and scope, of previous company research and/or development.

Assistant, and more controversial, criteria for allowability that will be applied usually to company-initiated development programs is that they must be "related to the product line for which the government has contracts [with the company]."

The revised ASPR also rules out the categorization of "unrelated" develop-

ment cost for and subsequent charge-off against defense procurement that might result.

The purpose of this provision is to prevent the use of taxpayer money to put a company into new types of business. But, in the fast-changing defense business, the provision probably will cause a number of thorny problems of interpretation.

For example, if a company is on another program, an ongoing under government contract but decides to establish a company program to develop another product or program, is the effort related to the program to fit which the government has contracts?"

Because the development effort is in another product field and for application to an other vehicle, the government can be expected to argue that it is unrelated. But from a strict interpretation of the revised ASPR, such development might be displayed as a new field of endeavor and one that the company should finance out of profit.

Reviewing Committee

The review committee of this sort, and to review proposed company-initiated research and development programs of major defense contractor's [7-1/2-Departmental Committee for Administration of Research and Development] is being established in the Defense Department and will include both contracting authorities and government scientists. The latter will include company programs and recommended whether they should be treated as research or development and related to production for ASPR purposes.

If a legitimate approach is used to interpret the related to contract production ASPR provisions, some observers fear it might lead to "bidding development," in which contractor-initiated development is designed to appear to be related to existing government products when, in fact, it is aimed at a new type of product.

Even though company-initiated research and development programs get over the hump of reasonableness and relate to existing production, contractors can expect to be asked to share the costs of such effort. The new ASPR Section 155 suggests that "cost sharing [between government and contractor]" can provide motivation for most efficient implementation of such program."

The service also says: "It is doubtful one can state that the government has less than an absolute share of the cost of this program." This can be done in several ways:

• Government accepts full costs of two specific projects as allowable items

of expense but completely disallows costs on certain other projects.

• Government accepts a percentage of contractor's planned research and development programs as allowable, with the company bearing the balance.

• Government and contractor agree on a maximum dollar value that will be treated as allowable items of expense.

Air Force Views

Explaining the reasons behind USAF's recent action, which initiated the new ASPR revision, as Air Force officials told *AVW* in an interview with *AVW*, the intent of company-initiated research and development is to make companies work to write off spent production costs, given the large leaps and bounds as the last several years. This, coupled with the increased amount of production, has caused radious rates to mushroom.

As a result, AFMC feels that a sizable portion of its funds intended for production of hardware is going to on-going company-initiated research and development, which actually is not the function of the command.

Company-initiated development has long been a source of friction between some of the services and some of the contractors. In the structure of the new ASPR revision, however, the effect of financial controls with defense funds, set the service has had no control over the direction of the company effort. Furthermore, the government normally does not obtain the prior rights as it does under direct government-sponsored programs.

Industry's position and perspective among companies which have major defense and commercial business, is that it is, and long has been, standard practice to conduct company-sponsored development and thereby the rest of us will benefit to contract production in an efficient manner.

Some industry representatives see the new rules as part of a continuing effort to dial down profit margins on defense business. Industries fear that some of the plans to pass profit higher profit margins on defense business to cover increased contractor expense from the development sharing plan. As one Defense Department official expressed it to *AVW*, industry will have to finance with effort of saving profits at the pier for driving ahead in defense technology to assist future business, or else cut off its development program.

Defense Department is now trying to work out the ground rules for applying the new ASPR principles to those two firms in interpretation for the three un-

set. Within the next four to six weeks, the Defense Department hopes to issue four contracts and have the Tri-Department Committee established.

Approximately 35 defense contractors known to have extensive engineering and research and development programs already have been invited to submit reports which describe their specific programs for evaluation by a group of government scientists which will serve on the Tri-Department Committee.

Union Opposes Industry Position On Japanese Electronics Imports

Washington-Electronics Information Asia has warned that the government must either restrict the import of Japanese semiconductors or else "wallow in a half-baked program of strict government assistance" in the U.S. semiconductor industry if it is to avoid the risk of a second rate electronic industry.

EIA's warning is contained in its answer to the recent Japanese request to the administration's policy committee along the lines of Civil and Defense Administration (OCDD) to take action to restrict imports of Japanese semiconductors from Japan (AWW Dec. 26 p. 24).

Opposing EIA's stand and supporting the Japanese position come from an unexpected source—the International Union of Electrical, Radio and Machine Workers (IURE), which recently filed a statement of union views with OCDD.

The IURE says that, as a representative of employees in the electronics industry, it is an eager as others to see that American industry and American workers are not hurt by unfair competition from abroad. But it urges the OCDD not to act on imports of Japanese semiconductors until further notice to determine whether the higher prices of U.S. semiconductors result from higher unit labor costs or from excessive profits.

Oring EIA over figures that U.S. industry's transistor sales for first 11 months of 1969 were up 67% over the previous year, while dollar sales were up by 40%, the IURE said, "it is very difficult to see that an industry which is growing so fast is in danger of being crippled by Japanese imports."

Figures released last week by EIA showed that during the 12 months of 1968, U.S. producers turned out 75% more transistors than in 1966, with dollar sales up 22% over the period of 1966. Electronics Information Asia points to government estimates that by 1964 approximately 230 million transistors will be required for defense needs. This, EIA points out, is two and one-half times the country's 1968 production.

Present plans call for the establishment of a single government/contractor cost sharing pool for such contracts to be used by all three services. The ratio will vary between contractors.

The Air Force originally had reached agreement on cost sharing ratios with at least four major contractors—General Electric, International Business Machines Corp., North American Aviation and Westinghouse Electric. The cost sharing ratios were not revealed.

Present plans call for the evaluation of new products and the possibility of large contracts and not because of possible speculative military needs," EIA says.

(During the same week EIA submitted its reply to OCDD, Transistor Electronic Corp., producer of diodes and transistor products for military and industrial use, reported Defense spending rates were up about 16% from the previous quarter, with savings up 12%. On December quarter rates of \$11.3 million, the company showed a 12% gain after a 12% drop in Q3.

The Japanese had cited several large U.S. semiconductor manufacturers who voluntarily chose not to make transistors. In the subsequent report, the Japanese also cited a decrease by Rockwell in sales prior to the increase of Japanese imports to abandon the consumer market and concentrate on military/industrial type semiconductor devices.

EIA contends that government semiconductor procurement programs contribute to technological improvements in military electronics, including semiconductor products. However, EIA says that, if an OCDD trade show's "dependency of the U.S. defense industry on foreign-funded research, a serious question will be presented as to whether it is appropriate to use such means preferentially to maintain life and vitality of the entire industry."

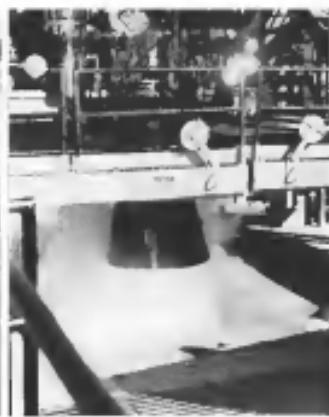
The IURE, in its statement filed with OCDD, says it believes "participation of responsible opportunity for Japan to export to us is necessary to our national interests. An inverse action against Japan would be construed by other nations as the beginning of similar actions against them, since there is no reason why a similar policy would not be applied to almost any country on which a substantial economic consideration can be dependent."

"There is no doubt," IURE says, "that the success of our country would be immeasurably worsened if to limit exports and after to impose actions in the trade field."

The union cites a number of U.S. electronics firms, some of whom domestic semiconductor producers, who have bought into Japanese firms and/or are negotiating licensing agreements or export arrangements with them. IURE says that "in the IURE's perspective, Japanese imports are threatening the national security of the U.S. and American companies are aiding these Japanese imports." The IURE therefore urges that "by the administration and Congress our companies are helping to undermine the national security." We are not willing to make such a charge, but does it not naturally flow from the nature of the very petition that has been filed?"



UNCOOLED test engine (left) for Rockwell's 1.5 million lb thrust engine has been run at over 1 million lb thrust. Test chamber is producing that power (right) when photograph was made. F1 is being developed for National Aeronautics and Space Administration.



Space Technology

NASA Studies Lunar Landing Projects

By Fred Eustice

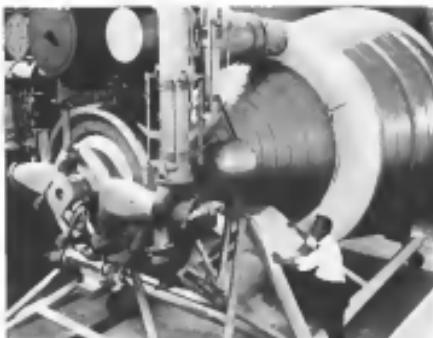
Washington—Soft lunar landing techniques for the Apollo-Centaur and Saturn boosters and gas cushion techniques to absorb the impact of instrumented land landings are under study by National Aeronautics and Space Administration.

Richard V. Range, NASA's assistant director of research for structures, materials and aircraft operating problems told the House Committee on Science and Astronautics last week that the gas cushion, because of its "attractive simplicity," is undergoing evaluation this month and experimental investigation in our research centers.

These Methods

These methods for safely landing instruments on the lunar surface were developed by Range—evaluable structures, penetrator spikes and gas cushion.

Under the latter—and most attractive—concept, the instrument payload is suspended from the module by a number of radial cords. Upon impact the gas cushion, until the initial vibration ceases, is not on the lunar surface, absorbing the energy by compression of the gas shock wave gener-



EARY FULL-SCALE model of the Rockwell F1 Rocket engine (AWW Feb. 2, p. 26) shows ground configurations. When checkout for repeat would produce up to 4 million lb thrust, sufficient to place about 150,000 lb of payload in a space orbit.

Unidentified Satellite Tumbling In Elliptical, Near-Polar Orbit

By Evert Chuk

Washington—Silent satellite that has been tumbling around the earth is a highly elliptical, near-polar-orbit satellite of least December still remained unidentified last week.

Second Fleet Defense Previews Assistant L. Makinen denied it was Rambutan, and the theory that it was a Lockheed Starstar satellite that had been lost in some earlier December orbital launching did not seem to match the facts available on December 10.

Details of the nonrotation and low orbit became public January 10, 1968. The second Fleet, Force of Defense Previews established then that the satellite was the satellite 2. It was later to detect more evidence that had been the orbital nonrotation evidence of its existence, as only December, however.

This claim was developed for Defense Department's Advanced Research Proj. 105 Agency by Naval Research Laboratories. The claim is not yet completely operational, its range is limited and magnetic tapes from the surveillance network must be scanned by the naked eye. There also is still a "300 m gap" in the series of the "fence," Navy calls the fence Spies, from Space Surveillance System.

Navy and the tracking stations indicating the satellite's presence were quite "satisfied" in its orbit and that the equipment is operational, the "fence" is not yet "extreme" part of the fence is attempting to track the vehicle. One figure mentioned publicly as the center range limit of Spies's equipment is 3,000 mi.

On Jan. 10, Navy began to suspect it had detected something and on Jan.

11, came to the conclusion that there definitely was an unidentified satellite in orbit, a "Navy spokesman said."

On Feb. 7, the surveillance headquarters at Nimitz's Proving Ground, Dahlgren, Va., notified the Navy Department and offices of the bid.

The object did not come into range of all of the nodes," the Navy spokesman said. "We would not get it every time and on some passes we would get only very faint tracking."

The satellite has a life expectancy of several months. Defense Department has not withdrawn or modified its initial statement that the satellite may be of Chinese origin.

Unknown satellite is Cuba first. The Soviet Union had no nonrotating satellite. The world knows all about our satellite."

Agents of the unknown satellite was 1.055 mi as of Feb. 12, and perigee was 199 mi. Period was 104.34 min, inclination of the orbit to the equator was 75.94 deg, according to the National Space Surveillance Control Center which is operated for the Advanced Research Projects Agency by Air Force's Aerospace and Control Development Division at Hanscom Field, Bedford, Mass.

Size of the satellite is reported to be 30 ft. in length, the size of the second stage of the Thor-Agena rocket used in December launching. The December launcher itself is considered to be about 15 ft. in diameter, weighing some 1,500 lb. after launch, plus a recently captured weighing up to 100 lb. Capsule is rejected from the Agena stage after an orbit is achieved.

One unconfirmed report and the object is about 20 ft. long-about the same length as a Douglas A-3 Skyhawk fighter jet in diameter. This would make it approximately the size of the last stage of the vehicle that launched Russia's March 1 lunar probe on Jan. 2, 1968.

Another wildasser theory is that the object is the Aga-1 from either the December V or December VI launching.

But the Surveillance Control Center lists December V as having failed to orbit as of Sept. 28 and December VI as having failed on Oct. 20.

Latitude of December V was 90.01 deg, close to the unknown satellite's 75.94 deg-but orbital records list an orbital apogee as only 450 mi perigee in 1963 with first orbital in 1961, when Russia would have enough weapons to test the strategic strike force. Decade was exploded in the Sibutu.

Indication of December VI was 84.8

deg, which is believed to be too far from the unknown satellite's orbit to allow the possibility that it is December VI. Official figures on December VI give an orbital apogee of only 577 mi and a perigee of 119 mi. Capsule was not recovered.

All other December are listed by the Surveillance Control Center as having failed from orbit except December VIII which still is in an orbit with an inclination of 80.65 deg, an apogee of 990 mi, a perigee of 173 mi and a period of 95.6 min.

December's many capsule entries a reentered but it is not believed that this satellite had it the power necessary to do this, the engine's orbit enough from that of the carrier rocket to account for the difference that appears between unknown's orbit and known's satellite.

The closest satellite would be the six launched in 1961. Apogee for the first satellite would be the same and Navy refers to it as "Unk. 1" as identification for the first unknown satellite.

Both the original entry and Navy's Spies are under AFPA's Project Shep lead, aimed at developing a satellite detection and tracking system. The Army was to have operated three CW-doppler complexes, called "Doppler," in the south central U. S. at Fort Monmouth, N.J., Ft. Monmouth, Okla., and White Sands Missile Range, N. M., but these appear to have been put into operation.

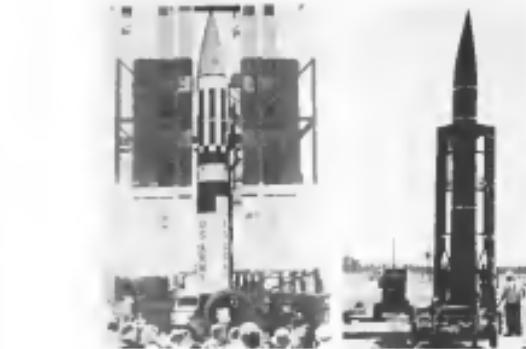
Chief of Naval Operations Adm. Alan Badie told a House Appropriations Committee subcommittee of the second stage of the Thor-Agena rocket used in December launching. The December launcher itself is considered to be about 15 ft. in diameter and 30 ft. in length. This is a very good rocket. A Navy statement responded by the subcommittee regarding Navy's interest in space said "All earth orbiting satellites in orbit can earth observation by the Spanish system and our new earth orbiting vehicle which carries the 'fence' will immediately be detected and added to the display pattern. The Spies system is currently furnishing operational satellite data as the data, in that manner and circumstances can be predicted."

French Nuclear Carrier

Participations of French first nuclear drives bring into sharp focus the still unanswered question of a common carrier or a separate delivery system for nuclear drives.

The 1966 budget forecast for 1968-69 Strategic 4th stage launcher test projections discuss still plans (AW Dec. 3, p. 121). Brossard claims it could begin delivery in 1963 with first orbital in 1965, when France would have enough weapons to test the strategic strike force. Decade was exploded in the Sibutu.

Indication of December VI was 84.8



Army-Martin Pershing Unveiled

Flat photo of Army-Martin missile with payload module (left), ready during Frenchman Exercise 2 trip to Cape Canaveral, Fla., shows the present configuration, in contrast with an early French test vehicle (right). Test vehicle is mounted on a mobile transport trailer. The Pershing is intended for mobile flights. Mobility, two Thiokol engines are situated at Hurlburt Field, Fla.

Vertol Shareholders Approve Boeing Pact

Vertol Aircraft Corp. shareholders have approved a plan for acquisition of Vertol by Boeing Airplane Co.

On Mar. 21 Vertol is scheduled to become the newest division of Boeing, continuing operations at its Martin St., Inglewood, Calif., plant and its separate corporate identity.

Vertol's shareholders approved the transaction at a meeting of shareholders.

Vertol's shareholders will continue to receive dividends.

Vertol's shareholders will receive

shares of all its 16,660 shares of

Vertol, valued at \$2,700,000.

These shares represent about 19% of the total shares outstanding. Boeing Gen. Sec. Corp. is believed to have exercised its option to buy them. Lucien S. Radcliffe, award, 118,315 shares of Vertol (about 39%) on Jan. 15.

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USAF Boron Award Goes to Callery

New-York Air Force jet boron fuel tank, the heaviest jet fuel tank with the achievement of a 55 million pound contract to Callery Chemical Co. for production of boron fuel.

The fuel tank is pre-oxidized, resins

resin, and the production of 100,000 lb of boron fuel over the next two years. The special boron fuel will be used at USAF's orbital engine development program. With 50 million pound as the limit, about 90% of the 500,000 lb is expected to be nonradioactive boron fuel.

The testing, which will start within six months.

Controlled by a jet engine, fuel tank with the aircraft at the North American B-70 program (AW Dec. 13, p. 26). The losses was last attractive to power jet fuel engine fuel. A number of aircraft and aerospace companies that flew

test flights. Air Force contracts for the study and evaluation of the boron compound as rocket propellants.

News Digest

Modifications in Boeing 707 and 720 series of jet transports ranging from 15 in. to 100 ft. in extension, fully boosted number and small control control (AW Feb. 8, p. 99) will be made on aircraft now in service along with those in production. Kits will be furnished to parent operators.

Aerospace Airlines last week received total net earnings of \$16,013,000 for the year ending Dec. 31, including \$16,613,000 in net profit from the disposal of property and equipment. The carrier ended 1969 with total revenues of \$177,700,000, an increase of 19% over 1968. Profits for shareholders and depreciation for the year amounted to \$11,346,000 as compared with \$12,991,000 in 1968.

Soviet Tu-144 turboprop transport came into service conducted last week at Ilyushin by the Port of New York Authority. The Russian previously had declined Pan Am's requests to test the Tu-144 and the Tu-144 turboprop transport, both of which have come into the New York market under special status from the authorities responsible for operation there. The Tu-144 is scheduled for its first flight on Mar. 20, when the route was to begin for Moscow.

Boeing Air Force is considering purchase of the Lockheed T-33A. Representatives of the Italian government have visited Lockheed Aircraft Corp.'s facilities at Burbank, Calif., to talk with executives of the company and to tour the production area. This also is coming during the Republic F-105 and Convair F-106.

Thiokol Chemical Corp. has completed a preflight test using test program on the XLR-59RL liquid propellant rocket engine rated at more than 50,000 lb thrust which will power the North American X-15 research aircraft.

General Division of General Dynamics Corp. received a \$212,000,000 follow-on contract from Bureau of Naval Weapons for additional production of advanced T-33 aircraft.

Lycoming T53-L-5 gas turbine engine, powered for the Vought F-8C Crusader fighter, has been signed to 200 deg. of aircraft weight (AW Feb. 15, p. 120). Weight increases constant at 375 lbs. power to weight ratio is 5.57. Enclosed rating, miles possible + turboprop model.

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to fill out a questionnaire, and the Decca radio flight log chart was required for analysis. Following is a summary of pilot comments (Where figures do not total 100%, the balance represents lack of pilot comment):

- Were there discrepancies between Decca charts and flight log chart after refueling? 24% yes, 64% no.
- Did any discrepancy occur between Decca charts and flight log during flight? 46% yes, 47% no.
- Were there any unavoidable occasions of the flight log during flight? 36% yes, 53% no. On the ground? 20% yes, 47% no.
- Did the same identification work properly? 68% yes, 32% no.
- Did the flight log acquire missing or present bearings when entering a Decca chart? 29% yes, 21% no. In flight? 39% yes, 31% no. In the approach charts? 47% yes, 29% no. In emerging Decca charts? 18% yes, 32% no.
- Were you able to comply with ATC clearance while using Decca? 39% yes, 50% no.
- Were you able to stay within power away structure area safely? 23% yes,

67% no.

- At any time were you unable to hold when prescribed holding patterns? 18% yes, 42% no.
- Were you able to navigate by use of Decca charts? 29% yes, 39% no.
- Were you able to use Decca without recourse to another navigation aid? 26% yes, 49% no.
- Did the flight log geographical presentation cause difficulties at any time? 21% yes, 37% no.
- Did route diversion cause a reduction in the use of flight log in time? 17% yes, 32% no.
- Did you find initial setting up of equipment to be difficult? 50% yes, 21% no.
- Did you believe equipment to be reliable? 74% yes, 25% no.
- Did you feel it possible to locate on approach points of the printed route? 46% yes, 53% no.
- Did operation of Decca equipment make it difficult to carry out other cockpit procedures associated with flight from tail-pilot IFR operations? 45% yes, 31% no. From single-pilot operation? 56% yes, and 3% no.

Vertol Studies Third-Turbine 107

New York—New York Airways has ordered an order for Vertol 107 twin-turbine helicopters [AWW Jan. 15, p. 41] with a third engine if needed for all-weather operation.

Robert L. Ciancamino, president of the helicopter airline, said the additional powerplant might be applied for air-sea rescue operations, although he hopes it won't. The 25-passenger aircraft will be equipped with General Electric GTE 1000 turboshaft engines. New York Airways expects to receive five 107s for service in spring 1961 and a final five by the end of 1963.

Price of the 107s, Ciancamino said, totals about \$9 million for the fleet of 10, a about \$1 million per aircraft and \$625,000 each engine, he quotes.

The order involves a trade-in arrangement with Vertol covering the airline's present fleet of five Vertol 44B 15-passenger helicopters. Vertol expects to fit the used 44Bs without difficulty, according to President Dan R. Bell, who said that there is an adequate market for them in other countries. Ciancamino said New York Airways itself had shown sufficient convincing possible purchase of the 44Bs "that look pretty nice."

With the first five Vertol 107s in operation, New York Airways has to face its arduous requirements to a greater extent of what this is now, Ciancamino said, reasoning the airline's grace to the more difficult it would. When all

10 Vertol 107s are flying, the airline should be able to operate 55 minutes out under a radar and to go off without, Ciancamino said.

With the new aircraft, New York Airways should be able to reach an operating performance factor of 85.925 at a "maximum altitude," Ciancamino said. Performance factor now averages about 75.500 annually, with a low of 61.500 during some months

humidity and temperature, rather than visibility, are the chief weather factors which hamper performance, Ciancamino said.

Next round of equipment planned for New York Airways is the 65-passenger Twin Rotolite VTOL, which Ciancamino said would be available in late 1964 and for which the airline has signed a letter of intent to buy. Ciancamino said the Rotolite has a small problem which he is convinced is of a metallurgical nature and which he is sure Passavant will solve. "But that I have to solve it before we'll touch it," he added and the manufacturer is "well aware" of the fact.

MATS Short-Term Contracts Awarded

Contract awards totaling \$1,700,266.27 this month were needed in time for bids to Makin Air Transport Service. Under the agreements, which are awarded periodically to MATS to meet the military's short-term transport needs, the carriers will move about 16,180 passengers and 500 tons of cargo via cargo planes along Atlantic and Pacific ocean routes during February.

Contracts awarded on Feb. 5 and 6 for cargo planes by MATS last week, were to the Flying Tiger Line, Inc. for \$103,917.47; Southern & Western Airlines, Inc. for \$434,384.18; Capital Airlines, Inc. for \$328,716.02; United States Overseas Airlines, Inc. for \$209,312; Transocean Charter Airlines, Inc. for \$665,573.55; Overseas National Airways, Inc. for \$123,091; Los Angeles Air Service, Inc. for \$51,340; Texas Caribbean Airlines, Inc. for \$39,350; and Trans World Airlines, Inc. for \$21,093.58.



FAA Tests Bell Aircraft Landing System

Federal Aviation Agency Douglas C-45 Monarchs aircraft in tested automatically through the final approach and landing by all-around automatic landing system developed for USAF by Bell Aircraft Corp.'s Aviation Division. System being evaluated at National Aviation Facilities Experimental Center Atlantic City, N.J. can prior to touch-down and radio to transmit control instructions to aircraft's automatic pilot.

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West Indies Status May Affect Routes

By William H. Gregory

Decisions status for the West Indies Federation are being made by British West Indian Airways which are likely to come in 15 months or less, but may bring with them some changes in airline route patterns in the Caribbean.

Independence of the islands, whose shares are 100% owned by British Overseas Airways Corp., depends not only on the attainment of dominion status by the Federation but also on whether the Federation will be willing to acquire the airline from BOAC for operation as a national carrier.

Despite some talk among the islands—especially from Jamaica to the larger in terms of population—U.S. government and industry sources believe the Federation will become a dominion of the British Commonwealth and that it will have the capital to make the airline "West Indian" successful.

Underlining this belief is the search by British West Indian Airways for jet equipment. Significantly, 10-month delivery is an important element in the order.

H. O. S. Wooding, BWIA chairman, recently founded a line of West Coast manufacturers. Other officials of the airline are continuing negotiations. A decision is expected in the next two months.

Transatlantic capability for the island's Jamaica-New York-London route (not yet being operated) is uncertain, although a long-range jet option would not be required for Caribbean-U.S. flights. The Convair 680 will be replaced by a wide-body stage of the Douglas DC-8 (AVW Jan. 4, '68).

British equipment also is being considered, and the order is almost certain to go to the U.S. Longer delivery dates for long-range British jets is the prime reason.

Lined transports might be used in the meantime on BWIA's only other route to New York, perhaps Douglas DC-7s in British registration. This route is now flown by BWIA's Viscount. Via coast 70/5 from Trinidad and Barbados to Bermuda, then Bermuda to New York, the route is flown in a RAMAC flight handled as a chartered flight by BWIA's equipment.

The Federation, looking toward its future status, has yet to determine of its impact will be on the U.S.-United Kingdom selected route which begins in Barbados this week.

U.S. airline sources are not so much concerned that the U.S. will face an direct conflict in the Caribbean. But there is some fear that there may be a repetition of previous events when the



BRITISH WEST INDIAN AIRWAYS Viscount routes and Douglas DC-8 routes (light lines) are supplemented by de Havilland Hornets operated by London-based Air Transport, a subsidiary, as routes with codefliers too small for the large aircraft.

U.S. has traded with Britain for rights in British possessions, and then found it had to back up all its gains for the same rights in the former colonies obtained independence.

Wooding told AVW's Wooding that he personally would like to see a BWIA route from Mexico City, where a full service is available, to the U.S. sooner much as Winter Air Lines. Otherwise, he would not discuss what route plans the airline might be officially formulating.

Hopscotch schedules will be a favorite point with BWIA. Two new routes are proposed by BWIA officials: • KLM Royal Dutch Airlines is to expand its BWIA as one of its principal competitors of the 10 airlines serving various islands in the Caribbean. Yet BWIA does not have routes to the Dutch islands of Aruba and Curacao in the Caribbean, let alone to the islands

in the Trans-Canada Air Lines system. Aruba, Aruba, Barbados and Trinidad form four islands between the Netherlands and the British Virgin Islands. Barbados is a major supplier to British Columbia. BWIA serves Georgetown, British Guiana and operates British Cessna Airlines for the British Guiana government.

Because of its geographic position, the airline has some natural advantages in stage lengths for handling at flights between North and South America. BWIA is interested in the South American market, but has been cautious on entering it up to now with the facili-

ties and more than a year ago was negotiating for a merger of Trans-Canada Air Lines and BWIA. The plan has stalled over some reported to the islands. TCA wanted to consolidate all transatlantic at Montreal, which would have meant closing BWIA's route to Port of Spain, Trinidad, and the loss of 100 jobs in West Indians.

Canadian government grants for federal funds to the area, however, and other jobs are lost. West Indians are not keen to the Caribbean end of the way from Amrit and Nasir Zaidan not because of English trade agreements. Canada sees West Indians major tourist and has little market interest in the islands. Another source of possible transatlantic traffic is BWIA's former, the one that goes into dominion. Routes like possible Jameson within the Federation, Barbados and major supplier to British Columbia. BWIA serves Georgetown, British Guiana and operates British Cessna Airlines for the British Guiana government.

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NEW BATTLEFIELD MOBILITY FOR CREW-SERVED WEAPONS

WITH THE VERTOL 107

The twin-turbine Vertol 107, prototype of the army YHC-1A light tactical helicopter, is giving new meaning to an old word — mobility.

In "shoot and scoot" tactics for crew served weapons, the YHC-1A can swiftly transport three 106mm battalion anti-tank rifles each with 4-man crew and ammunition. Terrain is no obstacle. Each crew and weapon can be dropped off at pin-pointed firing positions to ambush advancing armor with convergent fire. Within minutes they can be scooped up and redeployed to engage another target miles away.

With its rear loading ramp and unobstructed payload compartment, this helicopter has the ability to airlift a complete Little John system and crew, laying fire on a target 60 miles away 35 minutes after receipt of orders.

Vertol's advanced YHC-1A and the forthcoming YHC-1B (Chinook), provide battlefield transportation which equals the advanced firepower of MoMAR — Mobile Modern Army.



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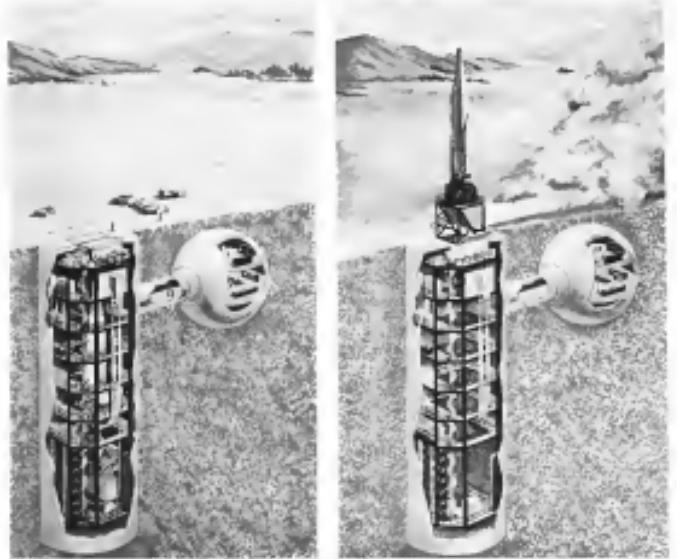
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MISSILE ENGINEERING



ARTISTS' conception of Atlas underground sites shows a mobile launching platform (left) and the ICBM itself (right). Countdown is conducted in a mobile underground control room. Control is exercised via fiber-optic link.

USAF Plans Six Hardened Atlas Sites

Los Angeles-Holbrook underground strategic launching sites will be constructed by the Air Force for six of the 15-Count Atlas intercontinental ballistic missile squadrons now planned.

The Atlas is targeted vertically to the new six assigned sites can be fired in less than 10 min. after warning of an enemy attack with only a minute or so required above ground for engine start. Thus engineers with a mission time approaching 70 min. for the Atlas as well as solid boosters which the missile must be used as a second option, several minutes above ground for propellant loading, fueling and checkout and firing time.

Cryogenic Tanks

The tank will be made of steel gusseted and bolted from the side by a network of splices. In addition to the Atlas the tanks will house and protect the two cryogenic tanks for storing the liquid oxygen oxidizer and the liquid hydrogen fuel for the missile. The tanks are to be buried in the lower 65 ft of the 140-ft deep checklist crib.

Improvement in combat firing time at the site will be gained partially

through storage of the RP-1 fuel in flight-ready condition in the missile's tanks and partially through the use of American Bosch Arma Corp's aircraft-grade solvent which is simpler to maintain in a tank than the tank inter-metal system. Missile launch under terrain conditions will differ from the research and development Atlas launch in that the missile will not be held down until the engines reach their peak thrust in an open position. The missile will lift off the pad in some in parallel to the engine thrust line above ground in a horizontal position.

Full scale mockup of an underground Atlas launching complex is now being constructed behind the Convair-Atomics plant at San Diego. The short-

proof crib has been elevated nine feet to protect it from traction along the ground.

One part will contain the missile housing and servicing section, with an oval clock spaced work levels to facilitate maintenance. The other part of the site needed will allow passage placement of the elevators, equipment, liquid oxygen pumps and tanks, fueling, heating, storage and communication equipment. Construction costs for the hardened squadrons installation is approximately \$10 million.

Sites Locations

Six squadrons locations for the sites listed. When six are now planned: Shilling AFM, Tucson, Ariz.; Los Angeles AFM, Los Angeles; North Harding AFM, N. Y.; Dugway Proving Ground, Utah; AFM site will be located in a remote, sparsely populated area. In each AFM site will be located a permanent ground room located a short distance away and connected to it by a buried No. 10 gauge system will have to be armored short, ground during the launch and engage housing portion of the AFM light from a hardened site.

Construction costs for a squadron at one of these sites and underground control rooms is estimated at \$600 mil. The sites will be located a little over than two miles apart, the actual distance depending upon the type of ground in which they are placed. Construction expenditure for a soft based AFM squadron averages about \$30 mil. less.

In these sites the missiles will be kept in a horizontal position in hold bags that will take very little more over ground than would occur in a launching site.

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Such a power plant—the Stirling-cycle engine—has a brake thermal efficiency of 30% operating in space environments, 40% in surface operations with conventional hydrocarbon fuels. Higher efficiencies when nuclear energy is used.

It is being built by Allison in cooperation with General Motors Research and the N. V. Philips Gloeilampenfabrieken of Eindhoven, Holland, who initiated the modern development of the 165-year-old engine.

Currently, Allison researchers, scientists and engineers are working under an Air Force contract to develop this engine for use as an earth satellite power plant. Other potential applications include portable or stand-by power packs.

And this is but one of the many space-age projects we're putting our minds to at Allison. Scientific, engineering and production minds that make up the new look at Allison—minds backed by every resource General Motors possesses.

Whether your problem is concerned with the heavens, the earth, or the ocean, Allison has the will and—if it can be solved—the way to solve it. We're doing it for others—we could do it for you.

*Illustrated is a segment of a lightweight, highly efficient solar reflector
developed by Allison for use with the Stirling-cycle engine.*





HOW *Blind Nutz* SAVE MANHOURS ON THE DC-8



©1968 BLIND NUT

The Blind Nut was selected by cost conscious Douglas engineers for use as a rivet in making the cockpit and passenger doors on all exterior passenger doors and emergency exit panels of the cabin-passenger-varied DC-8 luxury airliner because of its simpler and faster installation.

Each Blind Nut is installed in a single hole, in one operation and at a rate of about ten per minute compared to two additional conventional holes required for the installation of two rivets to attach each panel.

Considering that each door on the DC-8 uses several hundred or more Blind Nuts, a substantial number of manhours will be saved on each production airplane when compared to the tedious drilling and riveting time required to install conventional rivets.

Stainless steel Blind Nut set being used on aircraft and missiles in temperatures up to 800° F. in production and repair applications. They are easily installed with a hand-held, hydraulically actuated gun. Blind Nuts are available in grip strengths of 1/16" increments and range in sizes from 4-40 through 3/0-24.

Write for additional Blind Nut data
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March, 1970, with the wings, operated at the maximum from 2,000 lbs. to 7,000 lbs. to 1,000 lbs. above and below its design operating range.

Our model of the engine, designated AR-2, is now all that's new flight test plane in 3.5% lighter. The AR-2 is being developed for both blade instability on U-26 type aircraft to expand its speed and altitude envelope. Sales to date are the NATO and SEATO nations which were operate large numbers of U-26s. Japan reportedly is interested in the program.

AR-2 uses engine drive fuel from plane's supply tanks and propellants can be pressurized or bled up to the thrust chamber. The turbopump-fed to low pressure, up to flow thrust chamber in a center.

Participating in the AR-2, which is being in AR-1 and AR-4 as well has one centrifugal pump each for fuel and oxidizer, both driven from a common shaft and use gas generators. These prevent of oxidizer flow from the pump is directed through the shear control valve into a chamber in the gas generator where it becomes superheated steam to drive the turbine for the two pump. Pump, gas generator and other engine auxiliary equipment are connected around the first chamber to keep the insulation as small as possible.

This is an essential to pump fuel engine to keep the oxidizer free into the gas generator to control the thrust chamber and propellant flow rates.

Clayton generators which are 380 psi for AR-1 and AR-2, 400-415 psi for AR-3 and 500 psi for AR-4 are scaled and maintained to keep thrust at desired level. Propellant feed systems have fuel from the turbo pump outlet passed through a chamber pressure actuated fuel switching valve, then through the fuel injector into the chamber. Oxidizer is passed through the thrust chamber cooling jacket on the AR-2, regulator and through the nozzle walls on AR-3 and AR-4 engines with nozzle cooling jacket at these higher thrust levels. After performing the cooling function, the oxidizer passes through a chamber before entering the thrust chamber injector. The oxidizer enters thrust chamber at an oxygenate pressure and superheated steam at 1,567° F.

Starting sequence is completely automatic for the engine, and no ignition system is required. Oxidizer, with its oxygen rich and superheated steam, enters the combustion chamber before the fuel, and combustion occurs when the fuel is injected. Shutdown is automatic if operating limits are exceeded. All engines have an restart capability.

Our duplex is an oxidizer quantity feed and oxidizer pressure gage, jet fuel outlet gage and warning lights

AIRCRAFT WEEK, February 22, 1970

AMC Contracts

Wright-Patterson AFB, Ohio—Boeing is a list of unclassified contracts for \$21,000 and over as released by the Air Materiel Command.

McDonnell Douglas, St. Louis, Mo.—An unclassified contract for \$1,400,000 for the development, analysis, test, evaluation and engineering data for a missile system. The missile will be used for the final flight test of the Air Force's Advanced High-Speed Hypersonic Vehicle (AHS-HSV) and conventional Ma-11.

Avco, Waltham, Massachusetts, Avco, Waltham, Mass.—An unclassified contract for \$1,000,000 for the development, analysis, test, evaluation and engineering data for a missile system. The missile will be used for the final flight test of the Air Force's Advanced High-Speed Hypersonic Vehicle (AHS-HSV) and conventional Ma-11.

Westinghouse, Pittsburgh, Penn.—An unclassified contract for \$1,000,000 for the development, analysis, test, evaluation and engineering data for a missile system. The missile will be used for the final flight test of the Air Force's Advanced High-Speed Hypersonic Vehicle (AHS-HSV) and conventional Ma-11.

Rockwell, Palmdale, California—An unclassified contract for \$1,000,000 for the development, analysis, test, evaluation and engineering data for a missile system. The missile will be used for the final flight test of the Air Force's Advanced High-Speed Hypersonic Vehicle (AHS-HSV) and conventional Ma-11.

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Boeing, Seattle, Wash.—An unclassified contract for \$1,000,000 for the development, analysis, test, evaluation and engineering data for a missile system. The missile will be used for the final flight test of the Air Force's Advanced High-Speed Hypersonic Vehicle (AHS-HSV) and conventional Ma-11.

Pratt & Whitney, Hartford, Conn.—An unclassified contract for \$1,000,000 for the development, analysis, test, evaluation and engineering data for a missile system. The missile will be used for the final flight test of the Air Force's Advanced High-Speed Hypersonic Vehicle (AHS-HSV) and conventional Ma-11.

General Electric, Schenectady, N.Y.—An unclassified contract for \$1,000,000 for the development, analysis, test, evaluation and engineering data for a missile system. The missile will be used for the final flight test of the Air Force's Advanced High-Speed Hypersonic Vehicle (AHS-HSV) and conventional Ma-11.

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AIRCRAFT WEEK, February 22, 1970

Ultraviolet May Have Space Signal Value

By Barry Miller

Plainview, N.Y.—Ultraviolet waves show considerable value for signaling between the earth-or-in earth satellite—and space vehicles at planetary distances, according to Dr. Gerd B. Eller, a senior scientist on the staff of the GTE Division of General Precision Inc.

Eller is looking for the maximum potential in optical wavelengths below 1.5 microns to the next infrared for the past 15 months. After extensive calculations, he concludes that the 400 to 2,000 angstrom section in the ultraviolet band is the best option at 100 km. He says, "It is the best option for communication with existing equipment between earth satellite and space vehicles near Mars."

Similarly, he says, 3,000 to 4,000 angstroms would prove an optimum selection if the transmitting source was located on earth rather than in an earth satellite.

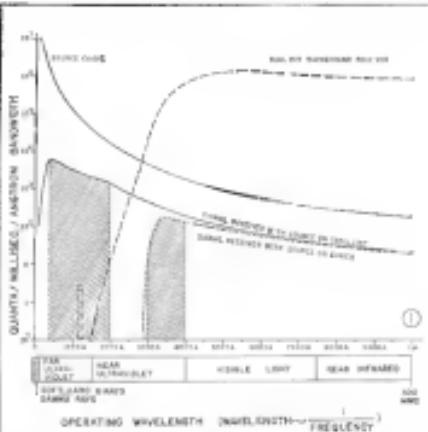
General Precision is one of a growing list of firms becoming interested in the feasibility of space communications at wavelengths throughout the optical spectrum (AVN Dec. 14 p. 37). Eller has suggested as a way of comparison with optical infrared and acoustic capabilities. It includes, besides General Precision, Technical Research Corp., Inc., Battison Co., Farrel Optical Co., Inc., Electro-Optical Systems, Inc., Servo Corp., Sperry Gyroscope Co., Electro-Optical and Avionics Division of America Bosch Aero-Controls, Inc., and other groups working on related devices and phenomena.

Government Support

Government agencies are supporting some wavelength research. For example, the Office of Naval Electronics-Optical Systems has a \$407,234 contract from Wright Air Development Division for an experimental communication system using deflected acoustic beams with cut sections to direct energy and reduce it in the re-emission cause by direct conversion.

Most of the work in optical frequencies is at GTE and elsewhere, however, in high theoretical or exploratory. While different portions of what is usually referred to as the optical spectrum—all the way from the next infrared down to the hard X-ray end—gains in importance, upper, priming, only further study and experimental work will reveal what their ultimate value will be.

This much seems clear, however, from studies like Eller's. Optical trans-



missions offer valuable and distinct advantages—solar, parabolic, long-distance transmission for satellites, and no extension of the space station of the orbital distance of an already established space station.

Currently, GTE is seeking Air Force funding to continue ultraviolet studies in the optical region. But the company, believing optical beam may be reliable in wavelength, coated and guidance as well as communication, will continue to subordinate this work, in the absence of government funding.

Design Problems

Eller considers the optical spectrum from 100 nm to the next infrared (1000 nm) as frequency through the visible, near ultraviolet, far ultraviolet and hard X-ray and gamma ray regions. He studied the overall parameters for a system with transmitter on earth, or in earth satellite, and the

receiver in a space vehicle near Mars when the planet is at the far distance of its orbit—a distance of about 210 million miles.

Resolving System

For the receiving system, he estimates that the space vehicle can carry a 20-ft diameter collector mirror which would focus the collected radiation onto a photomultiplier tube, as a photomultiplier, the former for ultraviolet or visible radiation, the latter for infrared. If X-ray radiation was used, a germanium heat counter could be the detector. Outputs from these devices can be amplified and then fed to the modulator devices.

On the sending end, a pulsed source with a light source at its focus would be selected to measure the amount of light reflected into the receiving collector. In this calculation, a transmitter mirror with a focal length

AMP taper technique points the way to greater reliability

Magnetic Amplifiers, Inc., of New York carefully manufactures its Static Inverters with a step-by-step quality control and testing program to build in the reliability required for aircraft and missile applications.

It found that AMP Taper Technique simplified this procedure. A high speed AMP Autowaxane pre-insulated circuit leads with crimp-type pre-insulated solid Taper Face Components are thus easily twisted in the modular stage before final assembly. Crimping eliminates difficult soldering operations and the danger of burning round components while Taper Technique prevents shorting and trouble shooting without destroying the main cable. After final assembly, when the PMS are inserted into the blocks, this Technique provides rugged vibration resistance and operational reliability.

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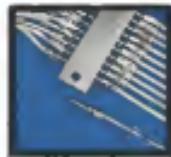
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MODERN PRODUCTION FACILITIES—The new modern Cannon factory building in Santa Ana has over 110,000 square feet of floor space, equipped with the latest production and test automatic plugging lines. This increased production capacity has been expanded especially for the production of the Cannon MS line of plugs.

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SPECIAL ENGINEERING
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FAIRCHILD—This new facility further increases the ability of Cannon Electric Company to provide test facilities of Cannon Plugs, connectors, and components, currently, STOCKED BY DISTRIBUTORS—Cannon Distributors, located throughout the country, stock the standard types of MS Plugs and can arrange for immediate shipment.



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Cannon is the only qualified source for the complete line of the new Glass R Plugs. MIL-C-4013D specifies that Class R Plugs shall have the "wire seating grommets in firm contact against the rear face of the insert." This requirement, now written into the spec, indicates how sharply built a Cannon design criterion for all MS environmental tested designs.

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• 15 different Grommets
All Cannon MS Plugs Conform to Military Specification MIL-E-9015D (ASG)

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of 35 ft, and a diameter of 30 ft was used.

Unless the same surface material is properly selected, some world signal will be lost due to a drop-off in signal intensity reference to the flat reference region. At 10,000 angstroms, the signal intensity is 95% effective and slightly less effective at 3,000 angstroms, near the edge of the far ultraviolet region. In the far ultraviolet, germanium, another possible source material, is estimated to be only 45% reflective, a figure which drops to 28% at 950 angstroms. In fact, this can also fall off in reflectance as the high intensity on the carbonyl-hydroxyl system at the shorter wavelengths.

Besides choosing large mirrors, the designer can increase signal strength by boosting the light output. One method of producing a bright source, and the one selected by Ellis for the study, is to pass high current through fine wires, thereby producing high temperatures and high intensity sources. With the expected wire technology, a 100,000A tungsten wire probably can be used to pass for use, although although its exact spectrum is unknown. The spectrum of a 22,000A exploded wire, however, can be used to approximate that of a black body.

Timed Flashes

With the exploded wire technique, a practical system can be designed to mechanically connect sections of fast wire to a circuit periodically, thus producing fused, perhaps carbon, links at the transition location. In his calculations, Ellis assumed that the fast and light source could be replaced from a 310,000A tungsten. Other possible sources, such as high intensity arc discharge, the propane expandable flame, and the sun itself might be used, but were not included in this survey.

Signal and background visibility for optical communications to a spacecraft near Mars at solar orbit were calculated and plotted in the graph on p. 63 using

the previously mentioned maximum separable path of the graph as follows:

• Signal strength or source output, which includes the output of a spherical black body, the area of the source, and the source intensity, is 95% effective and is useful with a 30,000A tungsten source. From right to left, this can rise to a maximum near 30 angstroms, fall sharply in the soft X-ray region. In the far ultraviolet, germanium, another possible source material, is estimated to be only 45% reflective, a figure which drops to 28% at 950 angstroms. In fact, this can also fall off in reflectance as the high intensity on the carbonyl-hydroxyl system at the shorter wavelengths.

• Signal received with source on earth surface, which includes the necessary constants for attenuation of optical source in the earth's atmosphere. Attenuation maximum varies from 90% at one source in the near infrared, up to approximately 91% in the visible region at 5,400 angstroms and drops to zero at 2,900 angstroms in the near ultraviolet.

• Sunlight background received, which represents the reflected sunlight from the earth, its clouds and its oceans.

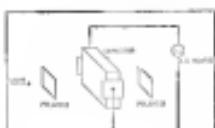


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MODULATOR SCHEME for optical communications. Ion charge is induced by passing of explosive discharge under influence of electric field to control light passage through galvanics.

of the transmitter source. The drop off is the far ultraviolet due to the poor reflectance at this very short wavelength.

A signal received with source on earth surface, which includes the necessary constants for attenuation of optical source in the earth's atmosphere. Attenuation maximum varies from 90% at one source in the near infrared, up to approximately 91% in the visible region at 5,400 angstroms and drops to zero at 2,900 angstroms in the near ultraviolet.

• Sunlight background received, which represents the reflected sunlight from the earth, its clouds and its oceans.

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The difference between a positive part, with all the stamp and service history the manufacturer can develop... and a dangerous bogus part is sometimes so hard to spot that only a distributor with close factory connections has the training to spot the true from the false.

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ENGINEERING
REPORT
ON BENDIX COMPONENTS

NON-BUFFERED CASCADED RESOLVER CHAINS

FOR NAVIGATION, GUIDANCE, AND RIB CONTROL COMPUTERS

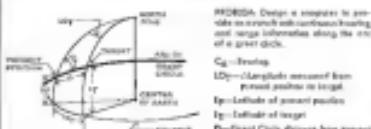
Newly-developed techniques enable Eclipse-Pioneer to solve coordinate transformation problems using less than 10% of smaller resolvers with performance exceeding massive chains using 250 resolver and feedback buffer amplifiers.

Our design philosophy is based on the premise that all component parameters will be allowed to fluctuate with variations in temperature for

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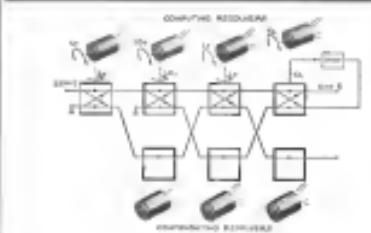
TYPICAL PROBLEM



PROBLEM: Design a resolver to provide an accurate coordinate transformation with minimum variations along the axis of a rigid structure.

Cg - Centering.
LDy - Length measured from point center to input.
Ep - Latitude of point passes.
Eq - Latitude of target.
D - Great Circle distance from point passes to target.

SOLUTION



Eclipse Pioneer Division
Teterboro, N.J.



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can be a recover collector current from its position near Mars.

The product of these currents and photoelectric efficiency is an indication of the received signal, the noise level is the square root of the number of emitted photoelectrons originating with the background count rate.

Signal-to-noise ratios were computed and the highest found to be in the 2,000 to 4,000 aperature region. These ratios are sufficient for sending a signal at one bit per 10th of a second. Mrs. Alessandro, if this added transmission distance was not needed, the signal transmission for this problem could be increased.

Using the same technique, however, the signal-to-noise ratio is poorest in the 4,000 to 10,000 aperature region but is sufficient to permit transmission with Mars when the planet is at the far side of its orbit. This distance could be passed. Ellis said, under these conditions if the photoelectric electrical signal were permitted to reverberate several times for this distance at a sacrifice in the transmission rate.

The signal-to-noise ratio for a single link from the earth transmitter to a soft client, however, for communicating with Mars at its closest point to earth a distance of roughly 36 million miles. Communication to the moon would be correspondingly easier, allowing an appreciable increase in noise transmission rate.

X-Ray Regions

Soft and hard X-ray and gamma regions were computed and found to be unsatisfactory for this application because of unfavorable signal-to-noise ratios. Signaling is possible by using the signal collection time to several seconds or minutes per bit, but this would make power requirements prohibitive.

Ellis cautions that his calculations are based on equipment known to be available. New components, such as spaced Moire wafers, which are being built, could alter the desirability of using the wavelength of the blue-violet region. Optical Moire, naturally, at any rate, are not expected to operate much beyond the visible region.

Various modulation schemes, based on mechanical, electrical and optical properties, can be used as optical communication. An illustration of one simple technique is the use of static blades of an electric fan to control the passage of a light beam.

To modulate magnetic inductance, according to Ellis, a Kerr cell might be used effectively. This requires two parallel-plate electrodes with one coated to block light passage. A container of a liquid such as methanol surrounded between par-

X-Ray Space Communications Studied

Watkins, Max-Kemp and high-energy particles will be investigated here as possible sources of space communications by Tencorol Inc., under a \$75,000 contract from the Rensselaer Polytechnic Institute.

The researchers will study the feasibility of generating, modulating and detecting X-ray and high-energy particles for communications systems which would operate beyond the limits of conventional communications links expected to be available by 1980.

Information may be conveyed by X-ray or charged particles such as protons at reasonable speeds across significant distances as space, for example, is proposed to the AIAA Finalists. Every requirement for an electron system, the particle source, ought to be comparable to that of a solar system. And perhaps a further advantage and detection of other systems should not differ appreciably from those of space equipment.

A severe limitation to the use of X-rays, however, is their inability to be focused, monochromatized, X-ray naturally fluoresces with the square of the distance from the source. X-rays may be focused by electron bombardment of a target material or by a reflective source, but the conversion of electron energy into X-ray energy tends to be inefficient.

Accelerated electrons themselves might be used for communication at a constant power, saving because a beam can be electronically focused into a restricted volume, the system's proposed indicator. Conversion efficiencies of 50% are conceivable. The electron source can be an arc discharge or an acceptable electron gun.

As an other radio communication technique, modulated amplitude methods can be a feasible. Characteristics of standard radio amplitude systems may be found in an high-rate to particle system. AM and FM modulation would become, respectively, variations in particle flux amplitude and energy modulation in an electron system. The former method might be less reliable because greater stability into calculations of signal strengths. As analogy with plane modulation could avoid fluctuations of signal strengths. As analogy with plane modulation could avoid fluctuations of signal strengths of energy levels, simultaneously reducing the system background. More complicated methods of representing patterns of amplitude and energy are also possible, according to Tencorol.

Since of the situation that modulated frequency gives X-ray equipment would be some played in space. The can be illustrated by a modulating system with a satellite. It might consist of a light-weight cylindrical balloon which would be inflated to a low pressure at the proper altitude. A filament located at the center of the balloon would provide a source of electrons which would be accelerated to the balloon's surface. The operation would be similar to a conventional gun-barrel X-ray tube. Because the input power would be dissipated over a large area, heat loss would be reflected again to this generates 1000 watts the generation possible with a terrestrial X-ray tube. Tencorol says.

Detectors for X-rays and electrons could be ionization chambers which might be made very large in space. A light-dissolved balloon perhaps 100 ft. in diameter, might be used.

First problem of these devices would enable the weight bulk power required must lifetime stability, modulability, repetition rate, and other factors. These would be compared with those of communication systems based on other solid light systems.

Dielectric plates to form a capacitor can be inserted between the polarizers.

With a greater spacing an after passing field from the capacitor, the optical properties of the liquid change thus altering the plane of polarization and permitting light passage at previously scattered materials.

Magnetic Anisotropy

A magnetic analog of the Kerr effect, in that case involving the Faraday effect, would replace the capacitor with an ordinary iron gauge in a magnetic field. An investigation of the Faraday effect in granular crystals is in progress at GTE.

Other modulating techniques in cluding application of the Faraday

current, voltage, and photoelectric effects might be possible. Ellis

Source throughout the optical range differs markedly. Lasers are more likely to be generated by applying a dc electric power to a ruggedized diode laser, i.e., one can be applied through a transformer to a source tube. This tube could be excited through ultraviolet bombardment.

In the gamma-ray region, radiation is generated by deionization of atomic nuclei. For shorter ranges, Ellis points out, the source could consist of a small mass of lead shielded radioactive material which could emit radiation when a source is passed in the shielding. More intense source can be obtained



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Shift and/or the digital assignments in switches.



For use with digital control systems, data processing equipment, or computers, these small devices convert analog information to binary digital form. But particularly useful to switches, they are also used in solid-state logic, logic converters, memory blocks, diode drivers, nuclear logic code. Each track leads a split for better switches. Unidirectional output giving short resolution in 2 parts in 128 can be provided. Ask for details on the many models available.

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ARRHINE portion of photo-transmission system is shown in arachnid concept. Components are central box (1) pictures box (2), magnifier (3) convex lens (4), lens case (5), stalks (6), scanner (7), transmisor (8), back envelope system (9), projector (10) and dark box (11).



GROUND EQUIPMENT for photo-intermission quantum analysis of radio sources (1), power levels (2 and 3), ANVGFG 1 tracking radio (4), plotting board (5), receiver and signal generator rack (6), monitor and antenna control rack (6), receiving antenna (7), ground control transceiver antenna (8), an omnidirection (9), and equipment shelter (10).



GROUND SUPPORT equipment for photovoltaic systems being selected by engineers includes: linear slides to support crystalline cell displays, concrete reproduction tanks, direct view cameras and photocells, extrusion coated tanks, and the sensors and sensors needed

CBS Photo Recon

selfed. Cross-F101 with a high-
salt avoid plant resistant to tri-
ketone developed by CBS Lohmann has
been delivered to an undisclosed
company, according to a company
spokesman.

The system can view images obtained by a sensor camera and convert them into signals for transmission from a mobile vehicle to a base station or to monitoring stations where the pictures can be reconstructed. Total time for a visual photographing to reproduction of film on the ground can be as little as 1 sec. CBS INC.

is, closest to the station in what is
known as a *omega CME*, known as a
"Stellar Tide."

ground station, the telemetered signals are reconstructed on a cathode ray tube to provide a rough picture. Higher resolution pictures (10 lines/mm in 7 sec.) are produced by a ground

Avalanche portion of the system, including the television transmitter, transmitter, two-stage processor, modified KA-16 camera, power and control unit weigh about 120 lb. The camera processor-camera equipment alone weighs 1,300 lb on, weighs 50 lb.

Transmission bandwidth of this system is 1.5 me with transmission of 2.25 kbaud. Future versions of this system which are now being negotiated for procurement will use the newly allocated 4.4 kbaud, to 5 baud units and have 4.5 to 6 me bandwidths, according to Edwards.

The owners will be entitled to fresh cartridges for night operations. Paraffin systems of this type are expected to handle infrared or night photos.



► Radio-Duct Crossroad—Teaching

a 300-ft-dia radio duct, produced by trade wind temperature inversions, at a height of 3,000 ft extending from West Africa to the east of Brazil, which generates propagation of VLF radio waves. In beyond-horizon directions, it has been confirmed by research at Naval Research Laboratory, Washington, D.C. (NRL Rep. 8, 1958, p. 23). Using frequencies of 229 cps and a transmitter power of only 100 watts, signals were detected by Navy aircraft at a distance of nearly 1,500 mi at the short-wavelength extremes of the spectrum. These signals were received at a frequency of 100 cps.

an atmospheric studies made by the Naval Research Laboratory, Air Force Cambridge Research Center and Electromagnetic Research Corp. Scientists predict that the radio duct should provide a stable transmission medium throughout the year with only a small seasonal variation in height. Suitable radio ducts are predicted for other trade winds areas, North Atlantic and North Pacific. The ducts are expected to penetrate the troposphere deeper than in the equatorial region, experienced in Pan American World Airways in its VHF ground-to-tropospheric scatter tests (AW Jan 18, 1958) as well as utilized for coupling solar energy into and out of the ion and duct from ground based transmitter and receiver.

► **Engineers: Enrollment Down** Despite continuing demand for engineers, fresh math/engineering enrollment in 1999 was 35% below 1988 which in turn was down 11% from the previous year, according to the Federal Office of Education.

► **Enoki to Join IBM**—Dr. Leo Enoki, Japanese scientist who discovered the tunnel diode, will join International Business Machines Corp. as a visiting consultant in the company's semiconductor research department at Poughkeepsie, N. Y. The tunnel, or Enoki diode is expected to find widespread use in digital computer circuits.

USAF: Senior Defense Initiatives-
Washington Electric will develop
processes and equipment for quantity
production of diamond-like grain single
crystal semiconductor materials under
use. Air Materiel Command contract.
USAF seeks to apply new techniques
to fabrication of low cost, reliable, air
resistive devices in silicon carbide (SiC).
Program is to begin in August 1989.
USAF: 1989-90. Under this development
diamond grain process, composite
resistor produces semiconductor crystal
in form of thin, narrow, high, pol-
ished slabs, eliminating need of SiC
crystal operations now required to
cut a crystal into thin and semi-
resistive devices. Under AF contract,
Washington will use silicon and gallium
arsenide materials. Company has
recently developed technique for grow-
ing a complete wafer conductor "with
each containing two parts that is

► **Tips for Designers—Application Notes** for Miltron, Recovery Technologies' supplement to *Military Handbook No. 211: Techniques for Application of Electron Tubes in Military Equipment*, which goes beyond the hand book in dealing with certain application problems commonly encountered in possible conversions has been measured.



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• Requires no refrigeration—can be stored indefinitely at any rate of launching rate.

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• Requires rough starts—which are due to acceleration of unrelated propellants in thrust chamber.

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► SAGE Radar for Traffic Control: Two of 12 SAGE-developed AN/FPS-15 SAGE radars are expected to be put into FAA air traffic control centers.

► Flat Plate Stabilized-Plane communication system employing condensers. Flat plate collectors in rectangular orbit around the earth is being studied by Air Force Cambridge Research Center. Flat surfaces provide signal strengths not obtained with far larger spherical reflectors of the type to be used in forthcoming satellite experiments.

► Scope Pattern Recorded-Laboratory prototype of a device which records in cellulose patterns an inkless, paper ribbon that on film and whose trajectory can be determined by the microscope is expected to be operated within a month at Electro Laboratories, Inc., 238 Main St., Cambridge, Mass. The process is electronic, not photographic.

► New Moletron: Electro-Radio Corporation of America is experimenting with several new types of solid-state transistors that are a good deal more power-handling than marketable so far. One is a biased transistor; an NPN device in which a biased diode serves as the emitter junction. Another, called an "oscillator," first reported in Soviet inventors, consists of a resonant diode crystal suspended in a d.c. magnetic field causing it to oscillate. Frequency can be varied by changing magnetic field strength. The oscillator, whose principle of operation is not fully understood, may also find application in a magnetron. RCA is also experimenting with two semiconductors today low at which the diodes can be varied by changing resistivity, but need to be combined with additional semiconductors, a complete integrated circuit register can be produced.

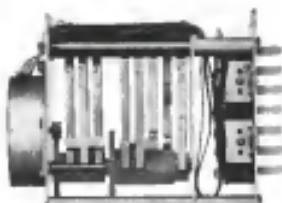
The following Patent Center items are compiled from recent and informal disclosure at the 1960 International Solid State Circuits Conference held in Philadelphia.

► Low-Noise Superconductive Amplifier—Superconductive amplifier with a

biased operation, and it will actually run for much longer. The circuit shows operation at 115V, 60 CPS, 2.5 watts power input. Its switch has been tested for 2 years (125 million cycles at 2 amps resistive 10VDC, 60 CPS) and is rated for 2.5 amp or a 7.0 amp switch lamp load. To be sure, other variations are available. A. W. Haydon will be delighted to quote these long-life, low-cost repeat cycle timers in any one of 125 standard speeds, 5 voltage ratings and 3 power supplies.

All have Jane type terminal plugs for fast installation, and a quick-change motor mounting device of motor replacement. Acetal plastic dust cover helps reduce noise level to a whisper. Write for information on your particular requirement.

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inserted wave figure of 0.6 dB, gain of 50 dB and operating frequency of 10 GHz was reported by M. Strell Institute of Techadag in Zurich, Switzerland. Superconducting switches which pass up to 1000 amp, but when broken, will rejoin at a set rate, have also been developed. Both are presently low power devices. Unigrid work in wave devices which started two years ago has now been completed in silicon.

► **Recti Diode** Enterspace, Peckham-Carrier, among engineers who have been designing Lissajous mode diodes into experimental circuits is that configuration for the new diodes has left four pads in pair for mounts and will have just as much of diodes each since diodes in next year at as 5000 in stable theory and provide uniform diode for them will pass through problem. Ultimate value, base current 100A, can be down to just 0.01 diodes can be stable and will enough technical problems can be lifted.

► **Thin-Film Memory**—Watch for the introduction of families of small, die-protected thin film memory by Burroughs Corp. at IITR Convention of Nucleonics.

► **Microinstrumentation Program** Pending—Each of six microinstrumentation programs will be introduced to a space industry in forthcoming months. Sensors will be mounted in cells, similar to example in the microelectrode program presently supported by Army Signal Corp. Fairchild Semiconductor will offer solid "metabolic elements"—complete semiconductor logic circuits packaged in single integrated headers to industry this year. Other programs will be run by Lockheed General Electric, in Dynetics and Bell Telephone Laboratories in Whippoorwill.

► **Inductance Diode**—Scintillator at distance 2000 which has potentially large inductance and high Q was described in a report by J. Nishizawa and Y. Watanabe of Research Institute of Electrical Communications, Tohoku University, Sendai, Japan.

► **Transistor Diode**—Tracing Wave Amplifier—Preliminarily housed, oscillating wave amplifier was reported recently by Bell Telephone Laboratories. First trade model produces 9 dB peak gain of 1000 cps above 1 GHz from a row of four germanium tunnel diodes in a three-line waveguide. Device uses ferite strip for unidirectional gain and has peak of bandwidth of 200-300 mc, according to Maurice E. Hayes who developed device with William W. Anderson at Bell Telephone Laboratories.

From Stratos...

NEW MISSILE AIR CONDITIONER for ground support



HIGH CAPACITY • LIGHT WEIGHT • VAPOR CYCLE

This new ground support air conditioning package by Stratos provides a cooling capacity of 30,000 BTU-hour when operating with an 8.5° F. 7,000 rpm motor compressor unit... and 50,000 BTU-hour with a 12.5° F. 7,000 rpm unit. Weighing only 350 pounds complete, mounting just 40" x 24" x 48", and rated at 3.3 or 4.2 tons, the Model VERA-3 air conditioner adequately demonstrates the high efficiency that can be achieved in a compact package due to the unique 16.4 P.E. compressor and efficient compressor and condenser. The rugged VERA-3 unit meets military specifications.

Specifications

Conditioned air flow	80-90 liters/sec.
Rated Temperature	Automatically controlled 65° to 85° F. ±2°
Weight	350 pounds complete with compressor, chiller and condenser
Heating Capacity	22,000 BTU/hour (15 kwhr)
Electrical Capacity	300 or 415 V. 3 phase, 60 cycle, 4 wire
Compressor	34,000 or 50,000 BTU/hr.
Controls	Remote panel, cable connected
Refrigerant	Brilliant, 100% chlorofluorocarbon

STRATOS

A DIVISION OF BANTERSON ENGINE & AIRPLANE CORPORATION
Box 5000, L. B. N.Y.

HRB-Singer Infrared Recon Photographs May Have Anti-Sub Warfare Application

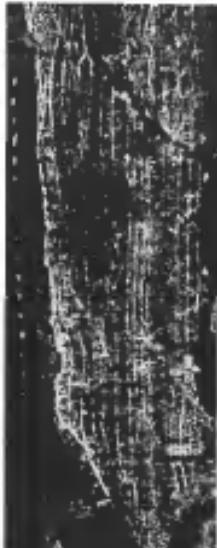
Significant improvement in infrared reconnaissance stat-of-the-art since the early 1950s is pointed up by infrared photographs just released by Department of Defense. Aerial photo made of Shishmaref Island (left) from an altitude of 4,800 ft at 11 p.m. with an infrared Reconstar system developed by HRB-Singer, Inc., subsidiary of Singer Manufacturing Co., shows high definition and resolution comparable to night vision, when the photo was made.

Infrared equipment with thermal high resolution, faster than any like instrument, operating at infrared wavelengths, in the 10-12 micron range of light, shown in the Bering Sea shot are clearly visible in the Times Square area. Equipment can detect slight difference in temperature between water alongside the ship and water temperature in the wake, indicating direction of vessel movement. This suggests possible application of infrared reconnaissance for anti-submarine warfare.

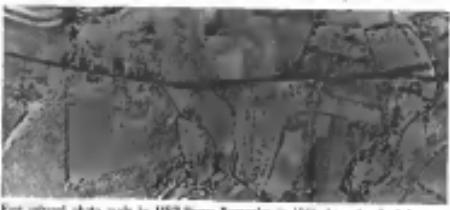
The HRB-Singer infrared reconnaissance system, developed under sponsorship of Wright Air Development Division's Aerial Reconnaissance Laboratory and the Army Signal Corps, is an infrared adaptation of an earlier visible light reconnaissance system developed by the company. Infrared photo is produced on a moving ship. This allows speed of vessel as a function of surveillance speed over the ground.

If airborne rapid-processing of film is incorporated in the system, and a radio data link transmitter is added, the infrared reconnaissance photo can be transmitted to ground station within a few seconds after photo has been made. This application of infrared system contrasts at another development for use by Army for battlefield reconnaissance.

HRB-Singer is actively engaged in development of both infrared and electro-optical reconnaissance techniques and systems. The latter include aqua-scan, radio frequency analysis and communications detection techniques.



Shishmaref Island, an area for infrared reconnaissance system developed in the early 1950s by Singer Corp. of America, which showed infrared vision potential.



First infrared photo made by HRB-Singer Reconstar in 1950, showing firebreak from an altitude of 1,800 ft, taken at 5 p.m. System used a lead sulfide infrared detector, which was an outgrowth of a photo reconnaissance system developed earlier by HRB-Singer.

Metalurgical Memo from General Electric



METALLURGICAL MEMO FROM GENERAL ELECTRIC

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René 41 is a trademark of the General Electric Company.



General Electric makes alloy in furnace shown. René 41 temperature range from 2200° to 2600° F. It has excellent strength and ductility at 1800° F. It has high temperature resistance and excellent weldability.

METALLURGICAL PRODUCTS DEPARTMENT

GENERAL ELECTRIC



GRAUMAN hydrofoil concept carries two craft on forward lift points and a single submerged foil on the stern.

Major Aviation Firms Survey Hydrofoil

By J. S. Betz, Jr.

Bethpage, L. I.—Maritime Administration word of a hydrofoil boat development contract to the Grumman Aircraft Engineering Co. affords a significant effort among major aircraft companies to move into this new ship building field.

Companies get into the field when an aircraft, dynamics, Developments Inc., was awarded a \$1 million contract to develop an 80-ton hydrofoil craft with a guaranteed 80-knot top speed by June, 1961 (AWW Feb. 1, p. 40).

Several agents are now interested in a Navy competition for development of a 45-kn. Patented Craft, Hydrofoil (PCH). Bureau of Ships is scheduled to choose a contractor in the near future, and aircraft firms face tough competition from the shipbuilding industry which is pushing hard to get into the field as it begins to receive serious government support.

Other aircraft companies besides Grumman which are reported interested in the PCH competition are Lockheed Aircraft Corp., the Martin Co., North American Aviation and Boeing Airplane Co.

Maritime Administration is interested that a large market for ocean

going hydrofoil boats will develop at least immediately on the scale of the two trials planned for the Grumman boat at the summer of 1961. Care and optimism surrounds the Maritime Administration-Dynamic Developments project because extensive experience with many types of hydrofoil design has accumulated since the last century, and considerable progress has been made since World War II.

Grumman's concept of hydrofoil aircraft systems has been evaluated by several hydrofoil firms with interest in the U. S. largely with Office of Naval Research support. Present conventional hydrofoil boats were all made abroad, however, and thus are not yet relatively preferred water, primarily in Britain, Italy and Russia.

Key Objectives

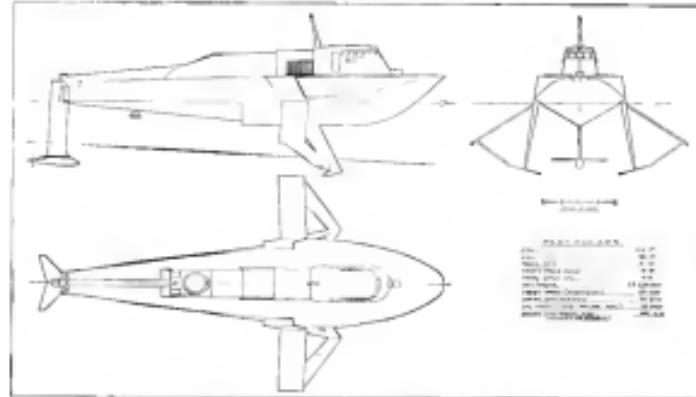
Key objectives of the current Maritime Administration project are:

- **Close-coupled demonstration** that a large hydrofoil craft can operate in all weather as has been indicated by research with smaller boats, even though the hull will be in water at a small percentage of sea states. Success of the Grumman boat is expected to prove the feasibility of hydrofoil craft from 100 tons and larger which can carry 500 or more passengers at speeds of better than 80 knots.

• First use of aircraft turbine engines on large hydrofoil craft, cutting the satisfied weight of the powerplant and its transmission system by a factor of about five.

The Grumman boat will be powered by a modified General Electric 750-turboprop designated the Model 240 with a free turbine wheel to take out about 33% of the energy on the exhaust stream to drive the propulsor in stern-shafting, using the right-angle gear layout. The maximum gross weight of the boat will be 100 tons, and the maximum speed of 80-85 knts. from the free turbine wheel to a single supercooled propeller which will turn up to 1,600 rpm. Total weight of the powerplant, transmission and gearings will be less than 18,000 lb., and this is radically smaller than competing equipment of the same power. Two Pratt & Whitney R7000 engines for instance, would be needed to provide equivalent power.

When the hydrofoil craft is operating as a displacement boat, the following low speed further navigation and during high sea states, a 900-kip auxiliary hydrofoil will be used for propulsion. The engine, a version of the General Electric T58, called Model 723, will provide ample power for maintaining the boat in the displacement condition thus avoiding the difficulties of using the 750 for this purpose.



RAVEN of this hydrofoil design would be 60 feet long at a design speed of 80 knts. Draft with loads up to 6 ft. 6 in.

Potential

Financial arrangements for the Maritime Administration project are a good reflection of the confidence Grumman and General Electric have in the potential of the high-speed, racing hydrofoil. The \$1.5 million from the Maritime Administration will cover less than half the delivery cost of the boat, and Grumman and General Electric are supplying the balance. General Electric Gear Division in Lynn, Mass., is providing the shafting and gear boxes.

Hydrofoils used on the boat are basically the same size and were developed and patented by William F. Cost and his company, located in Dynamic Developments in 1956. These hydrofoils are the author's patent type, and they were used on the Office of Naval Research XCH-1 hydrofoil boat built by Cost which could run at sustained speeds of over 70 mph.

The Cost design uses two main sets of surface-pushing hydrofoils about at the boat's center of gravity, with a single completely submerged foil as the stern support, by two vertical struts. The forward foils will carry about 80% of the boat's weight.

Sub-surfaceing foils will be used on the Maritime Administration boat, and it is expected that they will keep the



NOBILIS depicts two types of hydrofoils, model below has super-cooled propellers.



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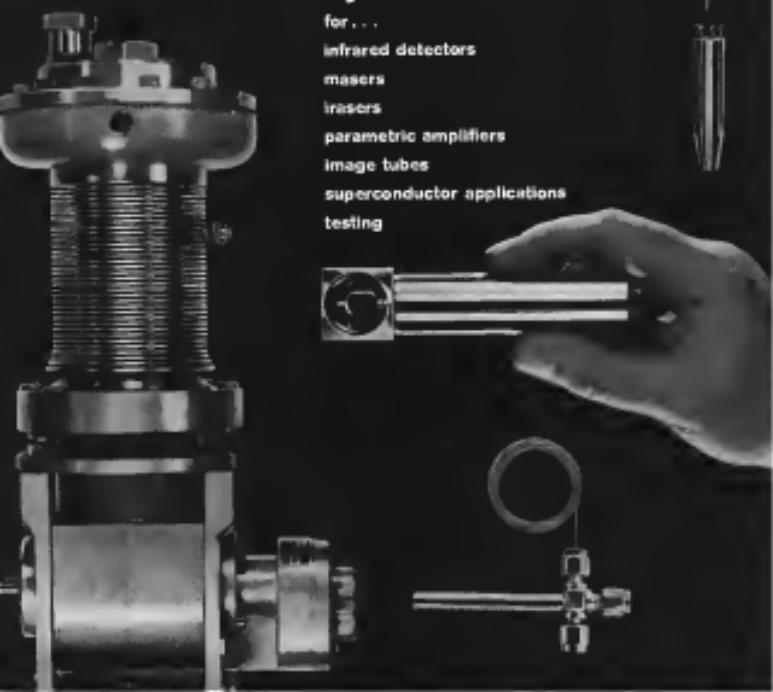
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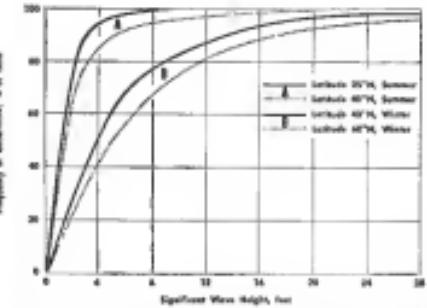
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multi-fluid, Joule-Thomson and expansion engine designs. Substantial data developed by Air Products is available to determine the most practical application of such systems.

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GRAPH shows varying frequencies of waves in the Arctic Ocean in summer and winter.

top speed under 50 ft. A large bubble of water vapor forms a cavity on the top surface of the hydrofoil as the lead pressure drags down to the vapor pressure of the water. On self-centering foils, this cavity forms and collapses at a high frequency and will rattle and shake the foil. This action limits the speed of this type of hydrofoil. The surface-pushing foil design usually alleviates the onset of vibration because air bleeds down the foil and sets in before the onset of water vapor bubble.

Centrifugal Solutions

The centrifugal problem has been approached in two main areas with the development of the super-centering hydrofoil. At high speeds, the possibility of the foil producing centrifugal pressure in the upper surface water vapor cavity in the cavity remains frozen and does not periodically collapse. Boat speeds up to 200 mph are believed possible with this class of foil.

The super-centering foil is shaped much like the MacCay sharp leading edge which has been used on aircraft that fly well above the speed of sound. Sub-centering hydrofoils resemble streamlining sections with rounded leading edges and long trailing edges.

The Maritime Administration boat will be designed for speeds above 100 mph so it can be used to test a super-centering foil system if the money becomes available to test one. A large amount of ocean power is also desirable for higher speed research, since only about 10,000 shp will be required using the sub-centering foil system at 50 kt, with about that much more still available from the 179.

Ultimate hydrofoil system, in the opinion of most marine engineers and hydrodynamicists, will consist of two

keep the subcentering foil system viable has been under development for some years. It was this type of hydrofoil or rudder testing unit on the boat to find a description of the waves just ahead of the foil and the angle of the foil to the wavefront of the foil can be adjusted in elevation level flight as wave height and duration of flow change. Adequate surfaces and submerged foil systems, however, will be available in time so that they will be used by the early or intermediate firms.

One of the big customers including the current Maritime Administration and Navy PC18 hydrofoil boats in full design. There are two main schools of thought, with one contending that the hull should be built like a suprise bottom and the other holding that it should be built like a destroyer.

Load Transmissions

The advantages of the suprise type construction and high strength-to-weight ratio, which is required to velocity supported by hydrofoil as it is to those supported by wings, and the ability to take high impact loads that normal boat bottoms are not designed to take. The "Y" bottom of a seaplane with its high dead rise angle, transmits a small load to the rest of the hull when it plows suddenly into a heavy sea in comparison with the load transmitted by the relatively flat bottom of the destroyer. As a consequence, destroyers and other naval vessels have to slow down in heavy seas due to the pounding on their bottoms when they pass through waves.

One of the arguments for the design-type hull is that it has better wave-keeping characteristics, which will be used during the times that the



GRUMMAN'S 100-lb-capacity hydrodynamic test facility uses in use for foil tests.

IMPORTANT DEVELOPMENTS AT JPL



GAS LUBRICATION

Research in gas lubrication and on performance and application of gas bearings is an important current activity at Jet Propulsion Laboratory.

The photographs shown are actual visualizations of gas flow patterns (obtained by an ultraviolet fluorescence technique) on a shaft under varying loads. Those on the left show pattern on an unlubricated bearing—those on the right when

bearing is loaded under 80 lbs. at 40 psi gas supply pressure.

These research experiments relate directly to the use of frictionless bearings in space vehicle components.

This is another example of the variety of supporting research and development being carried on at JPL to advance the national space exploration program.

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Super-rotating propeller is under development for Navy.



Foil shape is placed on test facility for water tunnel study.

you are so much that the hydrofoil cannot get up in its full and most be used in a partially-deployed form. This is answered by the development of the so-called type, bell for the demonstrated stability of the hydrofoil boat when the foil system is completely submerged into the water. The degrading forces have proven to be just as effective as gyroscopically controlled hydrofoil stabilizing fin systems for surface ships.

The hull of the Marconi Administration hydrofoil boat will have a stepped hull form complete with step and high-deadrise angle. Its aluminum, all-skeleton construction will be of an aircraft style with metal designs using relatively simple spaced frames and struts to take the high density lateral loading situation common to hydrofoils.

It will be stressed to hit a wave at least 100 ft. in the event that one of the foils sheers away.

Water propellers of the super-rotating type will probably be used on all four hydrofoil boats. Air propellers are considered more advantageous for lightly loaded boats.

Large numbers of hydrofoils were designed and evaluated during World War II by German army and navy, Hans von Schirach, now associated with a Swiss hydrofoil firm, Segner AG, was active in the program. The boats ranged between 4 and 62 tons and reached speeds up to 18 ft.

400 CYCLE NON-RECTIFIED AC SOLENOID VALVE



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CHALLENGE THAT 92 OTHER
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CREATION OF A DIRECT ACTING 400 CYCLE
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FOR A MOST UNUSUAL APPLICATION
INVOLVING WEIGHT REDUCTION
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from Sundstrand...

a major advance in turbine engine starter design

Sundstrand's new combination jet engine starter offers advantages of simpler importance as using conventional starters with the alert caution receptors and secondary actuation capability.

SAFETY. In this starting mode—crossover, high-pressure bleed air, and low-pressure bleed air are used. The two bleed air sources prevent pre-ignition, and ensure against multiple cascade ignition (see Figs. 1 and 2).

VERSATILITY. The linear starter is completely interchangeable for the F-100, F-105, F-106, B-57 Stratojet, and the KC-135. It is also readily adaptable to other starting requirements, including the F-104, B-52, and GAM-77. Adaptive features of the Sundstrand system make possible through development of advanced hot gas chemistry. Compatibility with both aircraft and airframes has been established by analytical and test flight evaluations.

SAFETY. The system can re-

place present programs, the starters

without changing existing

starter systems or operating

procedures, and provides

prebl'd, self-contained, cartridge mode
STATE-OF-THE-ART ADVANCES. Pressure-igniting valve circuits can reduce burst rate to obtain desired combustion of starting torque and mass—provided constant starting torque from -52° to +169° F—constant bleed pressure during starting, and constant bleed pressure during operation. Overpressure safety valve can be 100% piped and is reliable to eliminate a common trouble source. Integral shockwave duct controls pressure ratio across valve—pressure regulating valve is piped and also piped for pneumatic control. Speed limiters are a feature of the system, allowing for closing off starting modes and also during flight operations.

LIGHT WEIGHT. Sundstrand engineers have designed the new unit into a compact, light-weight module that weighs less than 60 pounds.

The Sundstrand one-relay/pneumatic system has been designed to automatically convert aircraft engine starters from the older B-57 series at Air Force installations, and is the first unit to successfully meet the desired first service for the B-52H. Based on analysis of starting torque and mass requirements, the new starter is also adaptable to the J-33, J-79, and J-70 engines.



Fig. 1. Schematic drawing of Sundstrand combination jet engine starter. Illustration shows single general output gear, single jetcombustion chamber, manifold block, and nine components of which five are integral.

Fig. 2. Cutaway drawing of Sundstrand combination jet engine starting system showing various components of the system and the various procedures for pressurizing aircraft.



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STABILIZING VADS extend from B-70 nose gear fairing note pre big (left) which breaks leading edge

EQUIPMENT



Encapsulated B-70 Ejection Seat Tested

By Irving Stone

Ingleswood, Calif.—Feasibility of an encapsulated ejection seat to permit survival in excesses of the North American B-70 intercontinental bomber has been established in over three 60-second parachute drops. The encapsulated seat, which will be used on the first four aircraft, is a single-seat, shoulder-mounted, self-deploying ejection seat. It is a one-piece, fiber-glass type shell that snap-seats from top and bottom, providing a straight and smooth ejection requirement for an oxygen mask or pressurized flight suit.

With the capsule operating at altitudes above 30,000 ft., new坐墊 would sit in a "sheerlike" environment. For ejection, the seat would invert into capsules to enable the plane to be brought to lower altitudes when ejection could occur without the capsule's protection. If it was necessary to abort the aircraft, each encapsulated crew member would be propelled through an ejection hatch. One of the requirements is that the capsule, a 54-ft. radius chord, could be deployed in less than a capsule landing shock would be absorbed by a large, inflated rubber bag on the bottom of the capsule.

If landing is made at cabin altitude, the



NORTH AMERICAN test pilot Al White demonstrates seat action in a capsule mockup

In Any Climate, Flexibility



SILASTIC Seals Fairchild F-27 Doors at -50 F

Fairchild's new F-27 project brings back the days of the versatile, multi-purpose transport. And one of the reasons this plane can fly anywhere, on straight or icy Alaskan runways, and carry a "flexible" payload is Silastic, the Dow Corning silicone rubber.

This sounds like a lot to ask of a door seal, but it does play a really important part. The F-27's for Northern Consolidated Airlines must be ready to roll in spite of -50 F ground temperatures.

And big cargo doors need Silastic seals because Silastic stays rubbery down to -120 or up to 500 F. With an ordinary rubber seal, the doors wouldn't open and close at -50. Silastic also resists equatorial sunburn, and springs back to shape after being compressed under load. So when the door opens



to load other passengers or cargo, it will come shut again as a reliable seal that keeps its original properties and holds cabin pressure.

This is typical of the many applications of Silastic in transports, helicopters, military aircraft and other types of planes...airplanes, too. Your rubber fabricator can engineer a part made of Silastic to your specifications. Or write Dept. 6062.

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AIR FORCE artist's conception of the B-70 Valkyrie is the first official view of the Mach 3 bomber and canard configuration studied by Aviation Week's artist in the B-70. The aircraft is shown flying at 30,000 feet, carrying a Dim-Sonar vehicle. Funding was cut to \$75 million for construction of two prototypes, with issue systems still open to review (AVW Jan. 23, p. 20).

capsule could float with the doors open. At a high altitude, the capsule would have to fly for more than 72 hr. In a crash test, the capsule would have closed. A popping radio antenna would prevent the capsule to transmit distress signals. If popped, the capsule has brakes and stability to right itself.

A demonstration of the encapsulated seat was performed here by Al White, North American's chief test pilot for the B-70 program. For several test runs, White sat well forward of the capsule perimeter, with complete freedom for arms and legs. With the pull of a lever, the seat moved rapidly off and chestfirst closed, in effect, putting White on a sealed pressure capsule. In this position, the occupant could begin to move his arms and legs. The capsule, however, had a hold of 15,000 lb. to about three seconds, whereupon the cover plate would be deployed. Recovery of the capsule could be from as high as 120,000 ft. If the capsule, undergoing potential use with space vehicles after launch or during reentry.

The seat also is designed for ejection from aircraft at speeds of 20 to 90 ft.

Economical and operational highlights of the B-70 were outlined by Program Manager J. F. (Biff) Jones. Cost for the first 100 operational planes, comprising 40-50-50 basic aircraft plus 24 flight test aircraft, would be approximately \$750 million. An average cost for the airborne, equipment, engines, quantity, etc. Total of five wings would involve a total cost of about 160-180 billion.

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During preflight checkout, ground power supply must be meticulously monitored to avoid damage; under-voltage, skipping overvoltage,

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prototypes could be produced for about \$40 million, Jones revealed, explaining that the second aircraft could be purchased for about \$60 million but a saving of about \$20 million would result in the flight test program with this second aircraft.

More than 9,000 hr of wind tunnel flight test have been accumulated.

The B-70 has the capability to be on alert for hours, but this operational technique would not be advisable since the aircraft could get off the ground.

Decisions were made to eliminate the use of kerosene fuel in the afterburners of the B-57's General Electric J47 turbojet engine when, in addition to high cost, research studies indicated that the aircraft could achieve using JP-4 alone, a 15% greater range than that established by SAC.

Elimination of horns fuel at the 8-70 operational altitude permitted substitution of JP-4 tanks for those originally designed by users the horns fuel. This also will simplify operational techniques by eliminating the need to finish the remaining horn tank with JP-4 to wash out coking which would be deposited on the inside of the tank from part of the aircraft.

Channel section also about 4 m. deep and spread about 8 m. apart follows the eastern slope. A bar has been about 3 m. square is located under the top slope.

Construction material on this hinge section is titanium alloy, whereas the bulk of the remaining aircraft structure is stainless steel incorporating a large proportion of honeycomb panels with titanium.

X-15 Research Plane Reaches 80,000 F.

EDWARDS AIR FORCE BASE
Edwards AFB, Calif.—North American Aviation's No. 2 X-15 reached 80,000 ft. high and set a new record in X-15 test program—after a drop from a Bomarc B-57 at 45,000 ft. Scott Crossfield pilot the ship to Mach 2.91 in 10 min. free flight with 4 min. under power.

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NEW AVIATION PRODUCTS



Pneumatic Starter Truck Supplies Electrical Power

Pneumatic truck containing a Boeing gas turbine driven compressor for providing starting air to jet transports also carries a General Electric 60 kva, 400 rpm, alternator for electrical ground support. The turbo-compressor is located on one and the alternator inside the truck. The alternator is powered by the Pneumatic truck's 312 cu in V-8 engine at 3,000 rpm. The truck was developed by Boeing Industrial Products Division and General Electric.

Lightplane Ice Detector

Ice formation on aircraft wings can be detected with an inexpensive optical device.

The detector consists of two translucent plastic rods placed in parallel a fraction of an inch apart on the aircraft wing. A light is beamed into one rod; a photodiode cell monitors the other. The formation of ice causes the light which is usually reflected in the second rod, to reflect into the second photodiode rod after reflecting the photodiode cell. The thicker the ice buildup, the more light reflected and the greater the current produced by the cell.

Ansco Research Foundations, Illinois Institute of Technology, Chicago 16, Ill.

Static Inverter

Inverter, developed for the Air Materiel Command, has a voltage regulation accuracy of plus or minus 0.87% and an efficiency of 85%.

The unit accepts 25 vdc to 115 vdc at 400 rpm, within a temperature range of -55 to +125°C. Frequency accuracy ± 0.5 rpm has been achieved with a stable frequency reference. The frequency source also controls the phase shuntbridge. The inverter, with no moving parts, weighs under 1 lb.

Electronics Department, Electrical Standard Division, Bendix Corp., Costa Mesa, Calif.



Servos Height Indicator

Height indicator shows height above the ground from zero to 100,000 ft. Two dozen or a greater vehicle altitude in thousands and ten thousands, and a pointer and dial depict altitude between zero and 999 ft. The instrument is not functional below 500 ft.

The T8610-11 has 1x and 25x mm dual control transformers, a double switching network, an AS185 transistored servo amplifier and a motor gear train driving the transformer, pointer and dial. Power requirements are motor generator 26v, 400 rpm, amplifier, 25 vdc. Pointer rotation rate is 30/30 rpm (as other directed).

The unit meets MIL-A-8224A and environmental performance meets MIL-8-5272B.

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BUSINESS FLYING

Beech Speeds Plans for Turbine Aircraft

By Ervin J. Balon

Beech Tex—business aircraft development and marketing program underway at Beech Aircraft Corp., Wichita, Kan., are aimed at producing a high improvement in the company's position in this fast-growing market in the next five years.

Some features of this plan have been detailed by a recently formed Beech Research and Development Committee and approved by a top-level executive committee. Vice-president-business sales Leslie E. Givens told Aviation Week that one of a羞ing to business aircraft is the company's new divisional listing a Travel Air with Astro-turbine engines.

It is evident that Beech will be taking some big strides to meet the bold concepts of this fast-track plan, both technically and in marketing. Techniques it appears, will be adopted as they develop a wide range of aircraft to make it conceivable with manufacturing on the low-budget price categories. Although the categories from \$15,000 to \$150,000 have been mentioned, it appears more likely that these actually are broad price ranges, rather than definitive goals. Choices are that the \$15,000 airplane should be closer to \$5,000, but this would still represent a major section of management thinking of the areas that Beech feels firmly has been overlooked.

Turboprop-powered business planes are far from today's than were a very age," Givens said.

Although Givens declined to elaborate on Beech plans for observations or light-of-color business by business aircraft, industry observers feel that turboprop business planes would probably be the most logical product of the 1965-70 period. Givens' rationale is that Beech now believes that these engines will be available in the 1968-1969 period.

Some observers told Aviation Week

that the chances are good that Beech will have turboprop-powered engines flying in at least two categories, including the light-twin field, in another two to three years.

(A Beech 18, fitted with Fairchild-Beech turboprops, has completed successful test flights here in January (AW Dec. 3, 1953, p. 112). Turboprop aircraft is fitting a Travel Air with Astro-turbine engines.)

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Another example of this could be the wing of the company's four-place category, now represented by the Bonanza and Del Norte and later the "515,000" airplane. These types would be considered a "mainly" a basic airframe, unapplied "set" wing.

Turbine Power

One of the decisions reached by the committee is that turbine power, particularly the turboprop, will be seen on production business aircraft including the light-twin category, much earlier than definitive goals. Choices are that the \$15,000 airplane should be closer to \$5,000, but this would still represent a major section of management thinking of the areas that Beech feels firmly has been overlooked.

Lower Price Market

Bonanza four-place aircraft is the first entry in the lower price market. Beech will produce. Sometime in 1961 these probably will be another airplane flying, bringing Beech into the \$150,000 price category. This airplane will be a low-wing model four-place with fixed tricycle landing gear.

It appears that the committee's thinking is that there will be large changes in engineering and production techniques,

soon. Flying out of military aircraft practice, will be used to bring costs down.

One of these techniques will be simplified construction to eliminate costly non-heat and parts. It appears reasonable that the company's engineers will attempt to develop some more lower-cost assemblies that might be inter-changeable between several models.

An example of this could be the wing of the company's four-place category, now represented by the Bonanza and Del Norte and later the "515,000" airplane. These types would be considered a "mainly" a basic airframe, unapplied "set" wing.

Bonanza Growth

With introduction of other four-place models, the Bonanza could be likely to "grow" out. From four seats it could go up to 400 hp or get an enlarged fuselage, new wings and tail. Another airplane that would develop a "fuselage" could be the Travel Air, which would develop into a turboprop version.

The Queen Air also is slated to move into turboprop and get a pressure cabin.

Such one of these steps would probably be planned two years ahead. For example, new features that will appear on the 1961 Travel Air will not be known until four years from now, so that the 1962 version of this airplane would look like.

In keeping with plans to greatly enlarge the sales line, Beech marketing the will undergo remarkable growth. It already is seeking to double its en-



Non-Roable Aero-Plane Makes First Flight

Aero-Plane four-place non-rotable version of the Venera, makes its first flight at Langley Field. The single gear aircraft uses the same licensing engine and flying wing as the standard Venera (AW Nov. 22, p. 106). Elimination of the Venera's non-rotable components provided the weight-saving necessary to carry four extra passengers in the Aero-Plane model which costs \$8,000.

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An enemy might be able to hit any point in the United States with a missile fired from a submarine. To protect us, the Navy must patrol millions of square miles of open sea. Task Group ALFA trains for the task. Ships and planes probe the bottom of the seas in an eerie game of cat and mouse with sonar sets so delicate they must tell a school of snapping shrimp from a pack of enemy "skunks," as unknown submarines are called. Our anti-submariners depend on steel—carbon steel, high-strength low-alloy steel, ultra high-strength alloy steels, Stainless Steel,

electrical cable, or wire rope. And United States Steel maintains the technical service to guide users in the proper use of these many steels and provide even better steels for the future. Before a program is ready for the drawing board consult with **UNITED STATES STEEL.**



With nearly silence, a helicopter leaves above a suspended submarine and descends a vertical into the water. Less than a foot off the submarine's transom, only sound bubbles from fall back to the helicopter when it once again changes. The craft is specially designed multi-control aircraft of steel and wire绳 made manufactured by the American Steel & Wire Division of U. S. Steel. It is the main work of 25,000 men and 400 subcontractors in the helicopter.

These B-57 "Bomarc" aircrafts long-range all-weather bombers. Engine and tail intakes on the wings are center million-dollar powerplants. It has 30,000 hrs of total flying and 40 aircraft operating.



CHAMPS VALLEY U.S.S.'s most important is a fleet of destroyers, including steel hulls and radio antennas that have been in constant touch with all elements of the fleet group. Her radio can reach around the world. She carries 400 officers, and has been awarded the Presidential Unit Citation and the Navy and A.D. Legion of Merit awards. Although not suited to battle, she can fly 300 miles in 10 hours. She has been selected by service to anti-sub needs.



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operated auto washer and parking facilities in Houston. Petrie became aware of the unusual potential through one visitations with his customers, who were highly technical executives. He obtained full data and more of these customers disclosed companies implies this had purchased and desired that this was a growing enterprise that he might get into.

A former World War II U.S. Marine fighter and bomber pilot in the South Pacific and survivor as a Cossack survivor on the West Coast during the Korean War, Petrie will put his full force into his new operation, negotiating his former interests.

Investment so far is approximately \$100,000—today's Breck distribution is to take him \$100,000 to \$400,000 and up to \$1 million in start-up. Petrie has his sights set on a volume of approximately \$2 million gross this year and the returns should be one of the top six revenue producers in the country, Breck claims.

Business Aircraft owners Houston, Galveston, Bay Port, Arthur, Lufkin, Beaumont, and Lake Charles plus 41 surrounding counties in Texas and Louisiana.

Aeroflot Develops Air-Drop Containers

Moscow-based Aeroflot has developed a wide variety of suspension canisters for air dropping loads weighing up to 7,000 lb. without wing parasites.

Nestled in such packages is protected in a sparsely populated area of the Far North's tundra tundra, where aircraft landings are difficult or impossible and where paragliders load droppage to parabolic frequency are carried away from the target area by strong winds.

Latest type of air drop package is to load automatically in a small, wrapped paper sleeve which separates the main load from the packaging. A weight paper of a maximum of 1 to 30 milligrams (10 milligrams to a dollar at the lowest rate of exchange). The sleeve can be torn apart or folded back "like a fan" but when expanded the article consists of many paper honeycombs with space in the center for a load weighing from 2.2 to 6.6 lb.

Aeroflot's largest air-drop containers are of the "parachute-type" type. One model of three or four large cylindrical bags held together by web with netting. Automobile or airplane transport tubes are also used.

Open ends of this "package" are closed with stiffened woven or vulcanized bladders. Aeroflot has this type of container can be assembled at an airport or several minutes and can be used for up to 100 air drops. Water bottles can



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The 8116/TE-37 Klystron tube contains ruggedized construction and thermal tuning. The construction provides a reliable tube for use in airborne radar and similar applications. Ruggedized construction provides a frequency jitter of less than ± 1.3 MC ... at vibration levels up to 10 G's at 50 cps. Thermal tuning provides a valuable advantage. It permits tuning the tube over its entire operating frequency normally without mechanical means... and the tube can be

repeatedly cycled throughout its tuning range without damage or deterioration. These Reflex Klystrons are but one example of how Bendix Red Bank technology can help you meet specialized tube needs. For information on these tubes ... and on back-to-wave oscillator and traveling-wave tubes ... write RAY KANE, DIRECTOR, RUGGEDIZED AVIATION CORPORATION, EASTONDALE, NEW JERSEY.



The 8116/TE-37, developed by Bendix, represents a family of 8116 tubes for use in airborne radar and similar applications. The ruggedized construction provides a frequency jitter of less than ± 1.3 MC.

The 8116/TE-37 is designed as the first ruggedized electron tube for use in airborne radar and similar applications. The ruggedized construction provides a frequency jitter of less than ± 1.3 MC.

The 8116/TE-37 is designed as the first ruggedized electron tube for use in airborne radar and similar applications. The ruggedized construction provides a frequency jitter of less than ± 1.3 MC.

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Helicopter Taxi Service Operates in Los Angeles

Nonstop helicopter taxi service is being operated between downtown Los Angeles and Los Angeles International Airport by Helibus, Inc., a charter operator. Helicopters are two Bell 212 Rangers leased from National Helicopter Service, a charter operator. The 212s are from the National pool. Additional helicopters will be made available from Southwest's fleet to meet Helibus' requirements. The service flies only during daylight hours, costs \$11 a person one way between the Pacific Electric Building (Interstate 109, 18th & 14th) and the airport. The trip takes 9 min. A downtown Helibus site will be operating at Pasadena within 90 days.

Closed-in suit packages have been dropped in ice from a height of 3,500 ft without breaking.

Most rugged type of air drop package used by the Russian airline is a square, rubber sphere with conical fins, angles, ridges or twisted surfaces. Contour such as this have been tested in winds at 500 ft.

PRIVATE LINES

Domestic delivery of U. S. business and utility aircraft totalled 114 units with manufacturing and selling total value of \$12,289,000, compared with 988 units shipped in December 1979 with a value of \$9,726,000. Total 1978 deliveries were 7,699 units with a total value of approximately \$207,000 and losses, compared with 6,424 units and having a total value of about \$175 million in 1977. Future shipments in 1979 were 904 total engine horsepower.

Production of Silvane propylene propylene plants is expected to reach 100 per day in 1980. With 1968's first quarter Silvane Aromatic Co., El Collins College will introduce new models this spring.

First Class dealer day in the New York area was termed a success after the dealer, Fletcher Aircraft Service, Inc., Teterboro, N. J., wrote a check for two Model 1000s, a Model 2100, and a

Skate during the weekend event.

High altitude charts (levels above 11,000 ft) for general aviation pilots are now available from Jeppesen & Co., Denver, Colo.

Dove & Co., Niles, Ill., has purchased a Douglas DC-3 modified for passenger loading and unloading office work by Executive Writers, Inc., St. Louis. Plans have been drawn accordingly to produce a 205-seat aircraft and send Tex Rocke, Dove's chief pilot.

Long-playing record catalog On Course On the Club Park is a new instructional aid for private pilot interested in water navigation. The record priced at \$7.98, is being offered by General Aviation, Inc., Santa Monica.

General Aircraft Engineering Corp.'s Ag Cat has been certified by Federal Aviation Agency for a 500 kg. licensing at a 470-lb. Pratt & Whitney engine. The agricultural helicopter is aircraft powered by a 220-hp Continental engine. The Ag Cat (FAW May 12, 1980, P. 311) was sold on 1979 base price for the open version is \$16,000; enclosed spray-dust model costs \$18,800.

PROBLEMATICAL RECREATIONS 2

"To stimulate his son in the pursuit of partial differential equations, a math professor offered his son \$5 for every equation correctly solved and in fact has \$5 for every unsolved solution. At the end of 26 problems, neither owned any money in the other. How many did the boy solve correctly?"

— Adapted from Gleason, 1968



Our comes-based tactical data system is the smallest, most complete, transactional digital system of its type. Engineers interested in creating efficient designs for digital and analog computers and associated input-output devices for these systems are invited to write Mr. Ray McNeirn.

ANSWER TO LAST WEEK'S PROBLEM: The conditions of the problem permit a second degree difference equation in two variables which can be factored. With the three sets of two solutions, taking into account the given conditions, i.e., number of vertices purchased equal to the average cost and the inequality of 60 figures more spent by each husband than wife, one can associate each couple. Hence the answer is A-C₁, B-B₂ and C-A₂.



LITTON INDUSTRIES
Electronic Equipment Div.,
Beverly Hills, California



HILLER 12E performance and capabilities can be increased with kit for installation of dual carburetors, dual carburetors, high compression pistons and turbo-supercharged engine. Hiller 12E is shown flying a helicopter to a destination of Cananea, Mexico.

Kits Extend Hiller 12E Capability

The Alto, Calif.—Having at 20,000 ft an maximum gross weight will be possible in the Hiller UH-12E with installation of a turbo-supercharged kit. Other modifications, also available in kit form, are designed for payload and performance increases as part of the planned growth potential built into the basic helicopter to 100 ft. for start. Costs:

Increasing seating capacity from three to four is possible by installation of a cabin enlargement kit.

Weight Increases

Gross weight increase caused by the modification is 33 lb. No modification is required in the power or drive system. However, a slight increase in performance results—lower net of ground effect (HOGGE) decreases from 3,000 ft. to 1,100 ft. and hover net ground effect (HNGE) decreases from 3,000 ft. to 3,400 ft. Seats are reduced from three to three to three to four.

For example, due to the added weight of the modification can be offset by increasing horsepower through the addition of:

* Dual carburetors. Adding 15 kg. while increasing gross weight by 30 lb., dual carburetors will boost HOGGE altitude

to 1,150 ft. HOGGE will increase by 1,100 ft., and service ceiling increases by 300 ft.

* High compression pistons. Replacing 100-110 octane fuel, either than 80-87 octane used, the new pistons add 2 lbs. to the gross weight while increasing the gross weight by 1,600 ft. HOGGE is 1,900 ft. and service ceiling is 2,000 ft.

* Combination of dual carburetors and high compression pistons. Result is an increase of 2,500 ft. in HOGGE as

estate of 2,600 ft. and service ceiling boost of 2,700 ft.

* Turbo-supercharged. Replacing V-140 engine, Hiller says that the new engine verification of which is expected soon will develop of which is expected soon will develop in full 450 hp. up to at least 18,000 ft. Thus, HOGGE, HNGE, and service ceiling all will be the same—30,000 ft.

Performance of a basic Hiller UH-12E at 2,700 ft. gross weight is HOGGE, 1,100 ft.; HNGE, 3,400 ft.; service ceiling, 14,000 ft. Maximum speed, vertical and forward rates of climb are unaffected by the modifications.

47Js Fly Schedules in St. Louis

Scheduled helicopter service, connecting St. Louis Municipal Airport with midwest and downtown Chicago begins this month with Bell 47 Rangers.

Mississippi Valley Helicopters, Inc. will again fly eight a day, Monday through Friday, using five 47s on each leg. All seats are reserved.

The company will operate a circuitous route from 100-50, featuring in downtown St. Louis, to major hotel and commercial district points.

Single passenger fare, between the airport and Forest Park, midwest, between downtown and the airport, is \$4. Fare between downtown St. Louis and the

airport is \$5. Counter rate structure is reflected in the fare.

The trip from the airport to Forest Park takes 30 mins. from the airport to downtown elapsed time is 90 mins.

The first flight of the day leaves the airport at 7 a.m. The last flight departs downtown at 4:30 p.m., arriving at the airport at 5 p.m.

Mississippi Valley Helicopters was established a year ago as a charter service (AVN, Nov. 16 p. 91) with one helicopter. It is first use of corporate fleet more than 400,000 passenger a total of 100,000 at 30 new episode for helicopter.

WHO'S WHERE

(Continued from page 23)

Changes

J. P. McNamara, manager of the newly formed Liquid Propellant Department, has been a division of North American Aviation Inc., Canoga Park, Calif. R. A. Wright succeeds Mr. McNamara as manager of the Northrop Mo plant, the San Clark, Canoga plant manager.

James W. Hinde, general manager of the Defense and Space Group of United Corp., Detroit, Mich.

Joseph J. Dwyer, manager of research programs, Douglas Aircraft Co., Inc., Santa Monica, Calif.

Mr. Charlotte Franklin, administrative public relations director, Yang, Salazar Inc., Inc.

Dr. W. Wu Chia, chief of research Veritas Inc., division of Sperry Rand Corp., Danvers, Mass.

Donald T. Roads, manager of sales test products and systems development at the Lockheed Corp., Long Beach, Calif.

George H. Prinsen, general manager, General Electric Co.'s Defense Department, Princeton, N.J.

Donald H. Farquhar, senior research engineer responsible for studies of the impact of advanced space vehicles. Also research engineer, aerospace division, Princeton, N.J.

Jack Wissack, flight operations manager, the Century Corp., Los Angeles, Calif.

Hal F. Shultz, head of Athens, Ga., search Corp., a division of Sperry Vought Corp., Atlanta, Ga., has been promoted to the vice group. David Bremmer, senior engineer, John W. Bush, Jr., supervisor, in procurement engineering. Joseph Baldwin, responsible for administrative functions.

Gilbert H. Lee, commercial director, British Overseas Airways Corp., London.

Dr. Donald F. MacIntosh has been appointed a vice-president research on the Space Systems and Research Laboratories of Lockheed Corp.'s Space Division, El Segundo, Calif.

Bob D. Davis, U.S. Army AFMIA and a director of his newly established Office of Foreign Operations, Atsugi, Kanagawa, Japan, Army, Calif.

Bruce Johnson, consulting manager, Halpern Division of Beddoes Instruments Inc., Princeton, N.J.

Frank F. Lafferty, director of The Voice Corp.'s Worldwide, D. C. office.

Dr. Robert W. Bass, chief scientist, Space Division of North American Aviation Corp., Belmont, Md.

Boeing Airplane Co., Seattle, Wash., has announced the formation of a new organization in the Division of Defense and Space products. William E. Knobell, assistant program manager, Boeing Helicopters, Seattle, was named first director. Bill Soden, customer support manager, Eliezer Sorenson, program growth manager, Robert F. Wall, program planning and control manager.

Stephen F. Gordan, director of engineering, Bendix Division of Bausch & Lomb Corp., Sodus, N.Y.

A New Role for The Mature Scientist

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created by RCA The fundamental mission of RCA's newly organized Advanced Military Systems Department is to develop new systems concepts that will satisfy military operational requirements in the period beginning five years in the future. In the establishment of this department, all problems of organization, personnel, financial, operating procedures and relations with other RCA organizations have been approached and solved with the firm objective of optimizing the ability of Advanced Military Systems to fulfill its mission. The result is, we believe, a unique organization operating in a uniquely creative environment.

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